Standard Size, 9 x 12. DECEMBER 10, 1896. Price, Six Cents.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE AMERICAN MACHINIST PUB. CO.,

VOL. 19. 256 BROADWAY, NEW YORK. No. 50.

CONTENTS.

PAGE

A 57-Inch Lathe..... 1141

Development of Gas Engines Abroad 1143

Metallic Lathing..... 1143

Keys and Keyways for Fly-Wheels.. 1143

A Diagram for Determining Diameters of Solid Round Shafts Subject to Bending and Twisting, and Arrangement of Drawing-Room Bluebook. By Henry Hess..... 1144

Credit Where Credit Is Due..... 1144

Electrical Speed Indicator..... 1146

Letters from Practical Men: Underground Trolley Lines. By H. L. Reynolds....Power Tests versus Time Tests—Electric Motor for Driving Machine Tools—Speed of Planers. By J. J. Flather....Centering and Shaft Turning—Accurate Surfaces on Wood. By Bell Crank....Lead Lapping a Steel-Lined Cylinder. By W. Y. Miggett....A Machinist's Spirit Level. By Mac....Flow of Water in Pipes. By W. Cooper.....1147-1149

A New Screw-Cutting Die Head... 1150

Worcester R. Warner, President American Society of Mechanical Engineers 1151

The New York Meeting of the American Society of Mechanical Engineers 1152

The Mechanical Engineers..... 1158

The Enforcement of Physical Laws.. 1158

Questions and Answers..... 1159

A Home-Building Enterprise..... 1159

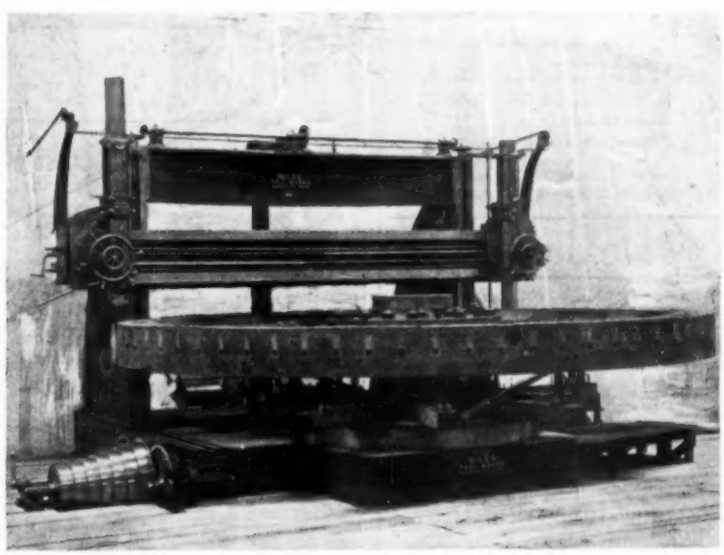
Commercial Review..... 1160

Index to Articles Advertised, Pages 10 to 13.
Index to Advertisers, Page 9.

A Labor Saver.

▲ ▲ ▲

Diameter of Work, - - - - - - - - 23 ft. 6 in.
Rim of Wheel, - - - - - 18 in. face and 18 in. deep.
Rim turned on TWO sides and face.
Time machining (housings in 24 ft. extended position), 48 hours.
Weight of Wheel before turning, - - - - - 139,611 lbs.
" " after " - - - - - 128,421 "
Loss of Metal, - - - - - - 11,190 "



16—24 ft. Boring and Turning Mill.

With Housings extended to 24-ft. position.

▲ ▲ ▲

Latest types of Labor-saving Machinery.

▲ ▲ ▲

WRITE FOR CATALOGUE.

The Niles Tool Works Company,

HAMILTON, OHIO.

BRANCHES: New York, Philadelphia, Boston, Chicago, Pittsburgh.

The Elliott Drill Press.

For any light work. Large Range. Low Prices. Ask for Catalogue.

Now Manufactured by

A. J. WILKINSON & CO.

180-188 Washington Street,
BOSTON, MASS.

WE HAVE A PULL

COUNTERSHAFT

PULL TO START
TO STOP

FULL PARTICULARS ON APPLICATION.

BUILDERS IRON FOUNDRY

PROVIDENCE, R. I.

Patterson, Gutfleisch & Hunter, Limited. New York City.
The Reason & Van Winkle Co. Chicago, Ill.
Syracuse Supply Co. Limited. Syracuse, N.Y.
R. Hatfield & Co. Chandler & Farquhar Boston, Mass.
Boyleston Tool & Supply Co. Cleveland, Ohio.

THREE YEARS' RECORD.

Flexible Roller Bearings

ARE SUPERIOR.

A fact which

"Reason Perceives, Experiment Verifies AND Experience Confirms"

HYATT ROLLER BEARING CO.,
General Office, 450 Market St.,
NEWARK, N. J.
New York Office, 26 Cortlandt St.

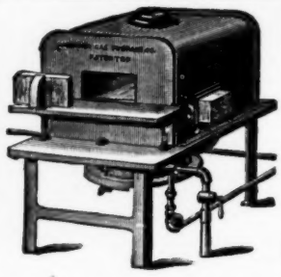
BRASS CASTINGS for all purposes. PHOSPHOR BRONZE for Machine Box Bearings, etc. Special Finished Brass Work to order.

NOLTE BRASS CO.
68 AND 70 EAST WASHINGTON STREET, SPRINGFIELD, O.

SPECIAL MACHINERY

Made to Suit You in
PRICE AND QUALITY.

JAS. P. WETHERILL,
CHESTER, PA.



AMERICAN GAS FURNACE CO.

Oil Gas Plants

Gas Blast Furnaces and High Pressure Blowers

FOR THE ECONOMICAL GENERATION AND SYSTEMATIC APPLICATION OF HEAT.

CATALOGUES ON APPLICATION.

No. 80 Nassau Street, NEW YORK.

English Agency: CHAS. CHURCHILL & CO., LTD., LONDON and BIRMINGHAM, ENGLAND.

R. Mushet's

THE STANDARD OF EXCELLENCE.

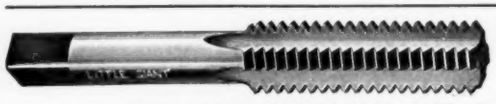
SPECIAL AND TITANIC STEELS.

B. M. JONES & Co.
BOSTON and NEW YORK.

You've been doing your grinding on an attachment rigged up on a lathe, haven't you? Used no water, and took plenty of time to get a job out? Stop a minute. One of our machines, specially adapted, on which plenty of water is used, will do the work in half the time and make a better job. That's economy. Send for full information.

LANDIS BROS., Manufacturers, Waynesboro, Pa., U. S. A.

AGENTS: { ENGLAND, C. W. BURTON, GRIFFITHS & CO., London and Birmingham.
FRANCE, AD. JANSSENS, 16 Place de la Republique, Paris
GERMANY, SCHUCHARDT & SCHUTTE, 59 Spandauerstrasse, Berlin.
AUSTRIA, " " 17 Breitgasse, Vienna.



FINE TAPS

OF EVERY DESCRIPTION.

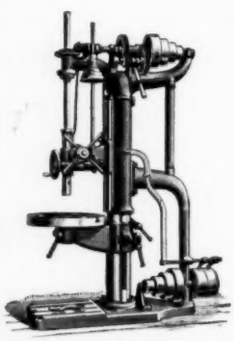
Manufactured by WELLS BROS. & CO., Greenfield, Mass., U. S. A.

WE DESIGN AND BUILD

MACHINERY AND TOOLS for All Purposes.

Or Parts of Machinery of any kind.
Models Built
and Inventions Perfected.

Write for estimates to
F. R. McMULLIN MFG. CO.,
General Office:
Suite 513-514, 218 La Salle St. Chicago, Ill.



FROM 14-IN. TO 40-IN. SWING.

Upright AND Radial Drills

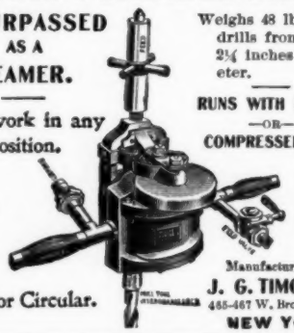
WITH Patent Automatic Stop.

AURORA TOOL WKS.,
Aurora, Ind.

MOFFET PORTABLE DRILL.

UNSURPASSED AS A REAMER.

Will work in any position.



Weighs 48 lbs. and drills from ¼ to 2¼ inches diameter.

RUNS WITH STEAM —OR— COMPRESSED AIR.

Send for Circular.

Manufactured by
J. G. TIMOLAT,
455-467 W. Broadway,
NEW YORK.

FILES RECUT BY HAND.

Hand Cut Files are best and cheapest in the end. : : :
We sell direct to users; write for new price list. : : :

REYNOLDS BROTHERS,
145 to 149 W. Spring St.,
COLUMBUS, OHIO, U. S. A.

New 20-in. Combination Drill,

A most valuable machine for general use. Ask for Drill Book C.

Sibley & Ware, S. Bend. Ind.

POWER PRESSES,

Punches and Shears, Reducing, Forming and Flaring Rolls, Power Hammers and Forging Machines.

DIES AND SPECIAL MACHINERY.

GODFREY J. BREMER MACHINE CO. Kalamazoo, Mich.

Write for Catalogue "A" and Price-list.

Metal Coiling Machines

For Sheet, Tubing, Rods, etc.,

The Torrington Mfg. Co.
TORRINGTON, CONN.

Index to Advertisers.

	PAGE
Abbott, Wheelock & Co.	43
Acme Machinery Co.	16
Albro-Clem Elevator Co.	6
Almond, T. R.	44
American Gas Furnace Co.	2
Ames Iron Works	46
Arcade File Works.	16
Armstrong Mfg. Co.	8
Audel & Co., Theo.	6
Aurora Tool Works	2
Baird & Co., Henry Carey.	44
Baker Bros	6
Ball-Bearing Co., The	9
Barker & Co., William	3
Bardons & Oliver	15
Barnes Co., W. F. & John	3
Bates, Henry H.	41
Besly & Co., Chas. H	41
Bethlehem Foundry and Machine Co.	13
Bickford Drill and Tool Co.	43
Bickford, H.	48
Bignall & Keeler Mfg. Co.	44
Bilgram, Hugo	11
Blaisdell & Co., P.	11
Bliss Co., E. W.	12
Boston Gear Works	46
Box 62	6
Bradford Mill Co., The.	11
Bradley Co., The	39
Brainard Milling Machine Co.	47
Bremer Machine Co., Godfrey J.	2
Brown & Sharpe Mfg. Co.	48
Buffalo Forge Co.	8 and 47
Builders Iron Foundry	2
Bullard Machine Tool Co.	14
Burr & Son, John T.	48
Carborundum Co., The	6
Chicago & Northwestern Railway	41
Cincinnati Milling Machine Co.	42
Cleveland Machine Screw Co.	6
Cleveland Twist Drill Co.	43
Clough, R. M	44
Coburn Trolley Track Mfg. Co., The	45
Coffin & Leighton	44
Columbia University	37
Conover Mfg. Co.	6
Consolidated Safety Valve Co.	48
Crescent Steel Co.	43
Crocker-Wheeler Electric Co.	5
Cumberland Iron & Steel Shafting Co.	4
Curtis & Curtis	37
Cushman Chuck Co.	3
Daimler Motor Co.	46
Dallett & Co., Thos. H.	44
Davis & Egan Mach. Tool Co	45
Deane Steam Pump Co.	16
Detrick & Harvey Machine Co.	47
Diamond Machine Co.	41
Dietz, Schumacher & Boye	43
Dixon Crucible Co., Joseph	45
Dyer & Driscoll.	39
Egan Co., The	3
Elliott Chemical Co.	45
Erlandsen, J.	37
Evans Friction Cone Co	45
Fay & Scott	9
Felt & Tarrant Mfg. Co.	37
Ferracute Machine Co.	13
Fifield Tool Co.	48
Pitchburg Machine Works	44
Flather & Co.	47
Forbes & Co., W. D.	45
Frick Co., The	46
Gang & Co., Wm. E.	37
Garvin Machine Co., The.	8
General Electric Co.	43
Geometric Drill Co.	3
Gisholt Machine Co.	4
Gooch, Chas. J.	46
Goodyear, S. W.	4
Gould & Eberhardt	8 and 16
Grant Gear Works	16
Gray Co., G. A.	16 and 40
Greenfield, W. G. & G.	46
Guild & Garrison	41
Hamilton Machine Tool Co.	15
Hampden Corundum Wheel Co.	3
Harrington & King Perforating Co.	48
Hartford Steam Boiler and Ins. Co.	42
Hendey Machine Co	38
Hill, Clarke & Co.	7 and 9
Hoggson & Pettis Mfg. Co.	3
Hoppes Mfg. Co.	41
Horton & Son Co., E.	3
Hurlbut-Rogers Machine Co	47
Hyatt Roller Bearing Co.	2
Ingersoll-Sergeant Drill Co	46
International Correspondence Schools.	6
Jenkins Bros.	39
Jessop & Sons, Ltd., Wm.	43
Johns Mfg. Co., H. W.	47
Jones & Co., B. M.	2
Jones & Lamson Machine Co.	16 and 48
Kempsmith Machine Tool Co.	47
Keuffel & Esser Co.	41
Keystone Engine and Machine Works.	46
Landis Bros.	2
Le Blond, R. K.	11
LeCount, Wm. G	3
Lodge & Shipley Machine Tool Co.	4
Long & Allstatter Co.	3
Maris Bros.	47
McCabe, J. J.	8
McFadden Co.	12
McMullin Mfg. Co., F. R.	2
Mergenthaler & Co., Ott	12
Mietz & Weiss	44
Miner & Peck Mfg. Co.	47
Montgomery & Co	43
Morse Twist Drill & Machine Co.	6
Mossberg & Granville Mfg. Co.	4
National Chuck Co.	3
National Machinery Co	4
Newark Machine Tool Co.	6
New Haven Mfg. Co.	48
Nicholson File Co.	16
Niles Tool Works Co.	1
Niles Tool Works Co., N. Y. Branch	8
Nolte Brass Co.	2
Norton & Jones Machine Tool Works.	6
Norton Emery Wheel Co.	39
Oneida Mfg. Chuck Co.	3
Otto Gas Engine Works.	46
Pancoast Ventilator Co	3
Penberthy Injector Co.	11
Philadelphia Book Co.	3
Pierce Engine Co.	46
Pope Tube Co	5
Pratt & Whitney Co.	39
Pratt Chuck Co.	13
Prentiss Tool & Supply Co.	42
Pryibil, P.	8 and 44
Q. and C. Co.	47
Rand Drill Co.	46
Reece, Edw. J.	41
Reed Co., F. E.	41
Reinecker, J. E.	45
Reliance Steel Castings Co., Ltd.	46
Reynolds Bros.	2
Rogers Boat Gauge & Drill Works John M.	42
Roots, P. H. & F. M.	47
Sackmann, F. A.	45
Saunders' Sons, D.	6
Sawyer Tool Co	41
Schultz Belting Co.	16
Sebastian Lathe Co.	39
Sellers & Co., Inc., Wm.	16
Seneca Falls Mfg. Co.	39
Shriver & Co., T.	43
Sibley & Ware	2
Skinner Chuck Co.	3
Slocomb & Co., J. T.	11
Snyder, J. E.	41
Springfield Gas Engine Co., The.	46
Standard Tool Co.	4
Stark, John	43
Sterling Emery Wheel Mfg. Co.	43
Stiles & Fladd Press Co., The.	12
Strelinger & Co., Chas. A.	44
Stuart's Foundry & Machine Works, R. J.	48
Tabor Mfg Co.	44
Taunton Locomotive Mfg. Co.	43
Timolat, J. G.	3
Toledo Machine & Tool Co.	4
Toomey, Frank	8
Torrington Mfg. Co.	2
Trump Bros. Machine Co.	3
Van Deren, C. T.	8
Vitrified Wheel Co.	11
Warner & Swasey	48
Waterbury-Farrel F'dry & Mach. Co.	47
Waterbury Machine Co., The	3
Watson-Stillman Co., The	10
Weber Gas & Gasoline Engine Co.	46
Webster Mfg. Co	37
Webster & Perks Tool Co.	37
Wedderburn & Co., John	48
Wells Bros. & Co.	2
Welis, Heber	13
Weston Engine Co.	46
Wetherill Machine Co., James P.	2
Whitcomb Mfg. Co.	4
Whiton Machine Co., D. E.	3
Wiley & Sons, John	39
Wiley & Russell Mfg. Co.	39
Wilkinson & Co., A. J.	2
Wilson, W. A.	13
Woodward & Rogers	45
Worcester Machine Screw Co.	47
Wyke & Co., J.	12
Wyman & Gordon	48

LARGE SIZES OF

Second-Hand Machine Tools.

• • •

1 **English Gap Lathe,** 27 in. swing over the ways, 54 in. swing in the gap, 28 ft. bed, gap 18 in. long; rod feed and screw cutting. In good running order. Price, $425.00.

1 **Gleason Engine Lathe,** 38 in. swing, 18 ft. bed, triple geared. In fine condition.

1 **Wood and Light Planer,** 36 in. x 36 in. x 16 ft., with one head. In fair condition.

1 **Putnam Planer,** 60 in. x 60 in. x 16 ft., with two heads. In splendid condition.

1 **Fitchburg Planer,** 60 in. x 60 in. x 20 ft. with two heads. In good running order.

1 **Powell Planer,** 66 in. wide, 36 in. high and planes 20 ft. long, with two heads on the cross-rail.

1 **Pond Planer,** 81 in. wide, 72 in. high, planes 12 ft. long, with two heads on the cross-rail. Practically as good as new.

1 **Pond Planer,** 96 in. wide, 84 in. high, planes 20 ft. long, has two heads on cross-rail and one head on each upright. Practically as good as new.

1 **Pond Boring Mill,** 6 ft. swing, with two heads. Old style, but in good condition.

1 **Pond Boring Mill,** 12 ft. swing, with two heads. In perfect running order.

We also have in our hands to sell a very large line of smaller sizes of machine tools.

CORRESPONDENCE SOLICITED.

• • •

HILL, CLARKE & CO.

14 S. Canal St., CHICAGO, ILL. — 156 Oliver St., BOSTON, MASS.

HUB THRUST BEARINGS

PATENTED.

Balls cannot wear in grooves.
Hardened surfaces ground true.
Balls specially gauged to uniform size.
Load equally distributed over all the balls.

HUB ROLLER BEARINGS.

Short Rolls accurately guided in parallel lines.

Rolls properly hardened, tempered and ground.

We furnish these Anti-friction Bearings for all shaft sizes.

THE BALL BEARING CO.,
10 WATSON ST., BOSTON.

Turret Lathes

Speed Lathes, Pattern Makers' Lathes, Engine Lathes, Planer Centers, and Special Machinery of all descriptions

MANUFACTURED BY

Fay & Scott, Dexter, Me., U.S.A.

ARE NOTED FOR HOW WELL THEY ARE MADE AND HOW WELL THEY WILL MAKE.

Write for Catalogue "D."

Buyers' Finding List.

ADDING MACHINES.
Grant Calculating Machine Co., Boston, Mass.

AIR COMPRESSORS.
Guild & Garrison, Brooklyn, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

ASBESTOS CEMENT FELTING.
Johns Mfg. Co., H. W., New York.

BALLS, STEEL.
Cleveland Machine Screw Co., Cleveland, O.

BEARINGS, ANTI-FRICTION.
Ball Bearing Co., The, Boston, Mass.
Hyatt Roller Bearing Co., Newark, N. J.
Mossberg & Granville Mfg. Co., Providence, R. I.

BELTING.
Schultz Belting Co., St. Louis, Mo.

BELT DRESSING.
Dixon Crucible Co., Joseph, Jersey City, N. J.

BICYCLES.
Pope Mfg. Co., Hartford, Conn.

BICYCLE TOOLS.
American Gas Furnace Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mach. Screw Co., Cleveland, O.
Davis & Egan Mach. Tool Co., Cincinnati, O
Diamond Machine Co., Providence, R. I.
Ferracute Machine Co., Bridgeton, N. J.
Garvin Machine Co., New York.
Geometric Drill Co., New Haven, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
Niles Tool Works Co., Hamilton, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Wells Bros. & Co., Greenfield, Mass.
Woodward & Rogers, Hartford, Conn.

BICYCLE TUBING.
Pope Tube Co., Hartford, Conn.

BLOWERS.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Boston, Mass.

BOILERS, STEAM.
Greenfield, W. G. & G., East Newark, N. J.
Weston Engine Co., Painted Post, N. Y.
Wetherill Mach. Co., James P., Chester, Pa.

BOLT CUTTERS.
Acme Machinery Co., Cleveland, O.
Davis & Egan Machine Tool Co., Cincinnati, O.
Detrick & Harvey Machine Co., Baltimore, Md.
Geometric Drill Co., New Haven, Conn.
Hill, Clarke & Co., Boston, Mass.
National Machinery Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reece, Edw. J., Greenfield, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich
Webster & Perks Tool Co., Springfield, O.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

BOOKS.
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant Gear Works, Boston, Mass.
Henley & Co., Norman W., New York.
Merriam Co., S. & G., Springfield, Mass.
Philadelphia Book Co., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Wiley & Sons, John, New York.

BORING AND TURNING MILLS.
Betts Machine Co., Wilmington, Del.
Bickford Drill & Tool Co., Cincinnati, O.
Bickford, H., Lakeport, N. H.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis & Egan Machine Tool Co., Cincinnati, O.
Newark Machine Tool Works, Newark, N. J.
Niles Tool Works Co., Hamilton, O.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., William, Philadelphia, Pa.

BORING AND TURNING TOOLS FOR GEOMETRIC SHAPES.
Geometric Drill Co., New Haven, Conn.

BOXES.
Prvibil, P., New York.

BRASS WORK, SPECIAL.
Nolte Brass Co., Springfield, O.

BRUSHES.
Buchel Machine Works, New Orleans, La.

BUSHINGS.
New Process Raw Hide Co., Syracuse, N. Y.

CALIPERS.
Brown & Sharpe Mfg. Co., Providence, R. I.
Standard Tool Co., Athol, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Wilkinson & Co., A. J., Boston, Mass.

CAMS.
Newark Machine Tool Works, Newark, N. J.

JACKS.

257 patterns, all sizes.

PRESSES

For all purposes. We have built the largest and the smallest hydraulic presses in this country.

PUNCHES.

All sizes and all shapes—a great variety. Portable presses a specialty.

Hydraulic Tools.

The Watson-Stillman Co.

"Jackmakers to the Universe."

No. 202 West 43d Street, New York.

STRAIGHTENERS

Powerful enough to straighten a four-inch shaft; special ones for rails.

SHEARS.

Power or hydraulic, for any sized material.

SPECIAL TOOLS.

We make more special hydraulic tools than all other makers in America. Our catalog shows a great variety.

Ask for Catalog D. A Book on Hydraulic Tools.

CARBORUNDUM.
Carborundum Co., Niagara Falls, N. Y.

CASTINGS, BRASS.
Nolte Brass Co., Springfield, O.

CASTINGS, IRON.
Builders Iron Foundry, Providence, R. I.
Shriver & Co., T., New York.

CASTINGS, PHOSPHOR BRONZE.
Nolte Brass Co., Springfield, O.

CASTINGS, STEEL.
Reliance Steel Castings Co., Ltd., Pittsburgh, Pa.

CEMENTS, ETC.—FIRE-PROOF.
Johns Mfg. Co., H. W., New York.

CENTERING DRILL.
Slocomb & Co., J. T., Providence, R. I.

CHUCKS, DRILL.
Almond, T. K., Brooklyn, N. Y.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Clayville, N. Y.
Prentiss Tool & Supply Co., New York.
Skinner Chuck Co., New Britain, Conn.
Trump Bros. Machine Co., Wilmington, Del.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Whiton Machine Co., D. E., New London, Conn.

CHUCKS, LATHE.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Chuck Co., New York.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Pratt Chuck Co., Clayville, N. Y.
Prentiss Tool & Supply Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Machine Co., D. E., New London, Conn.

CHUCKS, TAPPING.
National Chuck Co., New York.

CLUTCHES, FRICTION.
Bliss Co., E. W., Brooklyn, N. Y.
Evans Friction Cone Co., Boston, Mass.
New Haven Mfg. Co., New Haven, Conn.

COMPTOMETER.
Felt & Tarrant Mfg. Co., Chicago, Ill.

CONDENSERS.
Conover Mfg. Co., New York
Guild & Garrison, Brooklyn, N. Y.

CORUNDUM WHEELS.
Hampden Corundum Wheel Co., Brightwood, Mass.
Vitrified Wheel Co., Westfield, Mass.

COUPLINGS.
Stuart's Foundry and Machine Works, R. J., New Hamburgh, N. Y.

COVERINGS, NON-CONDUCTING, PIPE AND BOILER.
Johns Mfg Co., H. W., New York.

CRANES.
Maris Bros., Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

CUTTING-OFF MACHINES.
Armstrong Mfg. Co., The, Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., So. Sudbury, Mass.

DIES, SCREW-CUTTING.
Acme Machinery Co., Cleveland, O.
Besly & Co., Chas. H., Chicago, Ill.
Detrick & Harvey Machine Co., Baltimore, Md.
Geometric Drill Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Montgomery & Co., New York.
National Chuck Co., New York
Pratt & Whitney Co., Hartford, Conn.
Strelinger & Co., Chas. A., Detroit, Mich.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

DRAWING INSTRUMENTS, ETC.
Alteneder & Sons, T., Philadelphia, Pa.
Keuffel & Esser Co., New York.

DRILLING MACHINES.
Adt & Son, John, New Haven, Conn.
Aurora Tool Works, Aurora, Ind.
Barnes Co., W. F. & John, Rockford, Ill.
Betts Machine Co., Wilmington, Del.
Bickford Drill & Tool Co., Cincinnati, O.
Blaisdell & Co., P., Worcester, Mass.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dietz, Schumacher & Boye, Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Barker & Co. Cleveland, O.
Fox Machine Co., Grand Rapids, Mich.
Gang & Co., Wm. E., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hamilton Machine Tool Co., Hamilton, O.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.

DRILLING MACHINES—Continued.

Montgomery & Co., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Norton & Jones Machine Tool Works, Plainville, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Sellers & Co., Inc., Wm., Philadelphia, Pa
Sibley & Ware, South Bend, Ind.
Snyder, J. E., Worcester, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wells Bros. & Co., Greenfield, Mass.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Woodward & Rogers, Hartford, Conn.

DRILL GAGE.

Wyke & Co., J., East Boston, Mass.

DRILL RODS.

Abbott, Wheelock & Co., Boston, Mass.
Crescent Steel Co., Pittsburgh, Pa.

DRILLS, TWIST.

Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.

DROP FORGINGS.

Wyman & Gordon, Worcester, Mass.

DYNAMOS.

Crocker-Wheeler Electric Co., New York.
General Electric Co., New York.

DYNAMOS, NICKEL-PLATING.

Diamond Machine Co., Providence, R. I.

ELECTRIC MACHINERY.

Crocker-Wheeler Electric Co., New York.
General Electric Co., New York.

ELEVATORS.

Albro-Clem Elevator Co., Philadelphia, Pa.

EMERY WHEELS.

Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Hampden Corundum Wheel Co., Brightwood, Mass.
Montgomery & Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Sterling Emery Wheel Co., Tiffin, O.
Strelinger & Co., Chas. A., Detroit, Mich.
Vitrified Wheel Co., Westfield, Mass.

ENGINES, GAS AND GASOLINE.

Daimler Motor Co., "Steinway," Long Island City, N. Y.
Mietz & Weiss, New York.
Otto Gas Engine Works, Philadelphia, Pa.
Pierce Engine Co., Racine, Wis.
Springfield Gas Engine Co., Springfield, O.
Weber Gas and Gasoline Engine Co., Kansas City, Mo.
Webster Manufacturing Co., Chicago, Ill.

ENGINES, STEAM.

Ames Iron Works, Oswego, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Greenfield, W. G. & G., East Newark, N. J.
Keystone Engine & Mach. Works, Phila., Pa.
Weston Engine Co., Painted Post, N. Y.
Wetherill Mach. Co., James P., Chester, Pa.

FEED WATER HEATERS AND PURIFIERS.

Hoppes Mfg. Co., Springfield, O.
Taunton Locomotive Mfg. Co., Taunton, Mass.

FILES.

Arcade File Works, New York.
Besly & Co., Chas. H., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Nicholson File Co., Providence, R. I.
Reynolds Bros., Columbus, O.
Strelinger & Co., Chas. A., Detroit, Mich.

FIRE-PROOF CONSTRUCTION MATERIALS.

Johns Mfg. Co., H. W., New York.

FORGES.

American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Wilkinson Co., The Chicago, Ill.

FRICTION CONES.

Evans Friction Cone Co., Boston, Mass.

FURNACES.

American Gas Furnace Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

GAGES.

Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Rogers' John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Wyke & Co., J., East Boston, Mass.

THE WORLD RENOWNED

PENBERTHY

AUTOMATIC INJECTOR,

Starts Lower,
Works Higher,
Lifts Further,
Handles Hotter Water

THAN ANY OTHER AUTOMATIC INJECTOR.

SEND FOR CATALOG.

PENBERTHY INJECTOR CO.

124 Seventh Street, DETROIT, MICH.

Largest Injector Manufacturers in the World.

A NEW CATALOGUE

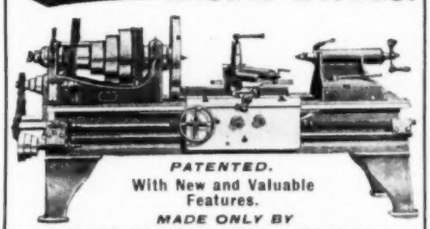
of Fine Machinists' Tools has just been issued by J. T. SLOCOMB & CO., Providence, R. I., and it should be in the hands of every thorough mechanic and believer in good tools in the best mechanical work. Ask for new Catalogue "E."

BEVEL GEARS

Cut Theoretically Correct.
Special facilities for cutting worm wheels.

HUGO BILGRAM,
Machinist,
440 N. 12th St., Phila., Pa.

HIGH CLASS ENGINE LATHES.



PATENTED.
With New and Valuable Features.
MADE ONLY BY

THE BRADFORD MILL COMPANY,

Catalogue "A" describes our Lathes, sent on application. CINCINNATI, OHIO, U.S.A.

ENGLAND—Chas. Churchill & Co., Ltd., London & Birmingham.

NEW YORK—Garvin Machine Co., Spring & Varick Sts.

EMERY AND CORUNDUM WHEELS,

The kind that cut and wear. Specially adapted for reamer cutter, gear, drill and all machine tool grinding, wet or dry.

"IRON AGE" and wire web wheels for snagging and rough work. Send for Circular "E."

VITRIFIED WHEEL COMPANY,
WESTFIELD, MASS.

London Agents, CHARLES NEAT & CO.

P. BLAISDELL & CO.,
Manufacturers of
Machinists' Tools
Worcester, Mass.
London Agts.: C. W. BURTON, GRIFFITHS & Co.

LEBLOND'S 12" 14" 16"
LATHES
BELT & GEARED
FEED
LARGE RANGE
Pearl & Plum, CIN'TI, O.

GEAR CUTTERS.

Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Mach. Co., D. E., New London, Conn.

GEARS.

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant Gear Works, Boston, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

GRAPHITE.

Dixon Crucible Co., Joseph, Jersey City, N. J.

GRINDING AND POLISHING MACHINES.

Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Landis Bros., Waynesboro, Pa.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Wells Bros. & Co., Greenfield, Mass.

GRINDERS, CENTER.

Barker & Co., William, Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Trump Bros. Machine Co., Wilmington, Del.

GRINDING MACHINE, CUTTER.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Wells Bros. & Co., Greenfield, Mass.
Woodward & Rogers, Hartford, Conn.

GRINDING MACHINE, SURFACE.

Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Machine Co., Providence, R. I.
Woodward & Rogers, Hartford, Conn.

GRINDING MACHINE, UNIVERSAL.

Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Machine Co., Providence, R. I.
Landis Bros., Waynesboro, Pa.

HACK SAWS.

Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Q. & C. Co., Chicago, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.

HAMMERS, DROP.

Long & Allstatter Co., Hamilton, O.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Stiles & Fladd Press Co., Watertown, N. Y.
Stiles & Parker Press Co., Brooklyn, N. Y.

HAMMERS, POWER.

Bradley Co., The, Syracuse, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Hill, Clarke & Co., Boston, Mass.

HANGERS.

Prybil, P., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

HOISTS.

Maris Bros., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

HYDRAULIC MACHINERY.

The Watson-Stillman Co., New York.

INJECTORS.

Penberthy Injector Co., Detroit, Mich.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

JACKS, LEVELING.

Newark Machine Tool Works, Newark, N. J

KEY-SEATER.

Burr & Sons, John T., Brooklyn, N. Y.

KEYWAY CUTTER.

Baker Bros., Toledo, O.

LATHES (see also Turret Lathes).

Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Dietz, Schumacher & Boye, Cincinnati, O.
Fay & Scott, Dexter, Me.
Fifield Tool Co., Lowell, Mass.
Fitchburg Machine Works, Fitchburg, Mass.

LATHES—Continued.

Flather & Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Le Blond, R. K., Cincinnati, O.
McCabe, J. J., New York.
McFadden Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sebastian Lathe Co., Cincinnati, O.
Sebastian-May Co., Sidney, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark, John, Boston, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells Bros. & Co., Greenfield, Mass.

MACHINISTS' TOOLS AND SUPPLIES.

Montgomery & Co., New York.
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.

MILLING CUTTERS.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Erlandsen, J., New York.
Garvin Machine Co., New York.
Reinecker, J. E., Chemnitz-Gablenz, Germany.

MILLING MACHINES.

Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clough, R. M., New Haven, Conn.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Forbes & Co., W. D., Hoboken, N. J.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Machine Tool Co., Milwaukee, Wis.
McCabe, J. J., New York.
Mergenthaler & Co., Ott., Baltimore, Md.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MOLDING MACHINES.

Tabor Mfg. Co., Elizabeth, N. J.

MOTORS, ELECTRIC.

Crocker-Wheeler Electric Co., New York.
Dallett & Co., Thos. H., Philadelphia, Pa.
General Electric Co., New York.

NEEDLE WIRE.

Abbott, Wheelock & Co., Boston, Mass.

PACKING.

Jenkins Bros., New York
Johns Mfg. Co., H. W., New York.

PAINTS, FIRE-PROOF.

Johns Mfg. Co., H. W., New York.

PATENT ATTORNEYS.

Bates, H. H., Washington, D. C.
Dyer & Driscoll, New York.
Gooch, Charles J., Washington, D. C.
Wedderburn & Co., John, Washington, D. C.

PATTERN LETTERS.

Montgomery & Co., New York.
Wells, Heber, New York.

PERFORATED METALS.

Harrington & King Perforating Co., The, Chicago, Ill.

PHOSPHOR BRONZE.

Phosphor Bronze Smelting Co., Ltd., Philadelphia, Pa.

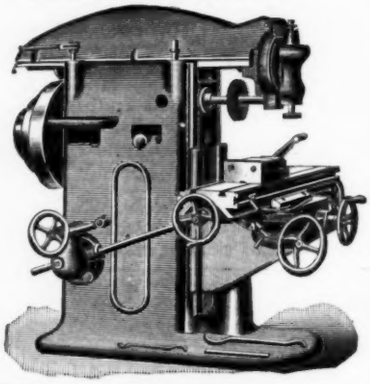
PIPE CUTTING AND THREADING MACHINES.

Armstrong Mfg. Co., The, Bridgeport, Conn.
Curtis & Curtis, Bridgeport, Conn.
Detrick & Harvey Machine Co., Baltimore, Md.
Geometric Drill Co., New Haven, Conn.
Hill, Clarke & Co., Boston, Mass.
National Machinery Co., Tiffin, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

PLANERS.

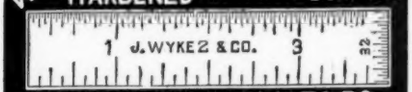
Betts Machine Co., Wilmington, Del.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Machine Co., New York.
Gray Co., G. A., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Ott. Mergenthaler & Co.,
BALTIMORE, MD.
MECHANICAL ENGINEERS AND MACHINISTS.
INVENTORS OF THE LINOTYPE.



Milling Machines
SPEED LATHES, SLIDE RESTS, MANDRELS, etc., Adjustable and Solid
Reamers.
All Kinds of SPECIAL and AUTO-MACHINERY Made to Order.
PRICES AND PARTICULARS ON APPLICATION.

WYKE'S IMPROVED END GRADUATED HARDENED MACHINISTS SCALES



SEND FOR DISCRIPTIVE LISTS TO J. WYKE & CO MFRS OF FINE MACHINISTS TOOLS E. BOSTON MASS.

Drop Hammers,
Presses,
Special Mach'y Dies.
THE STILES & FLADD PRESS CO.,
WATERTOWN, N. Y.

McFADDEN COMPANY.
TAPS & DIES · VISES · TWIST DRILLS · CHUCKS · MACHINE SCREWS · LATHES · FILES · STEEL TOOLS · STUBS
TOOLS
No. 722 Arch St., PHILADELPHIA, PA.

E. W. BLISS CO.
1 Adams St., Brooklyn, N. Y.
CHICAGO: 96 W. Wash'n St.
OWNERS OF
The Stiles & Parker Press Co.
400-PAGE CATALOGUE OF
PRESSES,
DIES, SHEARS
AND OTHER
BICYCLE, ELECTRICAL
AND
Sheet Metal Tools.
CORRESPONDENCE SOLICITED.
SPECIAL MACHINERY.
Drop Forging Plants Supplied.

"Stiles" Forging Drop.

PLANERS—Continued.

Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Wilson, W. A., Rochester, N. Y.

PLANER CENTERS.

Fay & Scott, Dexter, Me.

POLISHING WHEELS.

Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.

PRESSES, DIES, ETC.

Adt & Son, John, New Haven, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Ferracute Machine Co., Bridgeton, N. J.
McCabe, J. J., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
New Doty Mfg. Co., Janesville, Wis.
Stiles & Fladd Press Co., Watertown, N. Y.
Stiles & Parker Press Co., Brooklyn, N. Y.
Toledo Machine & Tool Co., The, Toledo, O.

PUBLICATIONS.

Home Study, Scranton, Pa.

PUMPING MACHINERY.

Greenfield, W. G. & G., East Newark, N. J.
Guild & Garrison, Brooklyn, N. Y.
Deane Steam Pump Co., Holyoke, Mass.
Wetherill Mach. Co., James P., Chester, Pa.

PUNCHES AND SHEARS.

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Davis & Egan Machine Tool Co., Cincinnati, O.
Long & Allstatter Co., Hamilton, O.
McCabe, J. J., New York.
Mossberg & Granville Mfg. Co., Providence, R. I.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson-Stillman Co., The, New York.

RAW HIDE.

New Process Raw Hide Co., Syracuse, N. Y.

REAMERS.

Cleveland Twist Drill Co., Cleveland, O.
Mergenthaler & Co., Ott., Baltimore, Md.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

ROCK DRILLS.

Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

ROLLING MILLS.

Mossberg & Granville Mfg. Co., Providence, R. I.

ROOFING ASBESTOS.

Johns Mfg. Co., H. W., New York.

RULES, GRADUATED STEEL.

Coffin & Leighton, Syracuse, N. Y.
Darling, Brown & Sharpe, Providence, R. I.
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

SAWS.

Q. & C. Co., Chicago, Ill.

SAWING MACHINES, METAL.

Q. & C. Co., Chicago, Ill.

SCHOOLS.

Columbia University, New York.
International Correspondence Schools, Scranton, Pa.

SCREW MACHINES (see Turret Lathes).

SCREWS, MACHINE.

Cleveland Machine Screw Co., Cleveland, O.
Flather & Co., Nashua, N. H.
McFadden Co., Philadelphia, Pa.
Worcester Machine Screw Co., Worcester, Mass.

SCREW PLATES.

Machinists' Supply Co., Chicago, Ill.
Reece, Edw. J., Greenfield, Mass.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

SCREWS.

Cleveland Machine Screw Co., Cleveland, O.
Worcester Mach. Screw Co., Worcester, Mass.

SEPARATORS, STEAM.

Keystone Engine and Machine Works, Philadelphia, Pa.

SHAFTING, ETC.

Cumberland Iron & Steel Shafting Co., Cumberland, Md.
Prvibil, P., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

SHAPERS.

Betts Machine Co., Wilmington, Del.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.

SHAPERS—Continued.
Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co. Boston, Mass.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

SHEARS, ROTARY.
Bethlehem Fdy. & Machine Co., South Bethlehem, Pa.

SLOTTERS.
Betts Machine Co., Wilmington, Del.
Niles Tool Works Co., Hamilton, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

SOLDERING FLUID.
Elliott Chemical Works, Newton, Mass.

SPECIAL MACHINERY.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Geometric Drill Co., New Haven, Conn.
McMullin Mfg. Co., F. R., Chicago, Ill.
Ott, Mergenthaler & Co., Baltimore, Md.
Toledo Machine & Tool Co., The, Toledo, O.
Wetherill Machine Co., James P., Chester, Pa.

STAMPS, STEEL.
Sackmann, F. A., Cleveland, O.

STEEL.
Abbott, Wheelock & Co., Boston, Mass.
Crescent Steel Co., Pittsburgh, Pa.
Jessopp & Co., Wm., New York.
Jones & Co., B. M., Boston, Mass.
McFadden Co., Philadelphia, Pa.

TAPPING MACHINES.
Woodward & Rogers, Hartford, Conn.

TAPS AND DIES.
McFadden Co., Philadelphia, Pa.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

THREADING MACHINES.
Webster & Perks Machine Tool Co., Springfield, O.

TOOL HOLDERS.
Gould & Eberhardt, Newark, N. J.

TRAMWAYS, OVERHEAD.
Coburn Trolley Track Mfg. Co., Holyoke, Mass.

TUBING, FLEXIBLE.
Almond, T. R., Brooklyn, N. Y

TURRET LATHES (Screw Machines).
Bardons & Oliver, Cleveland, O.
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Cleveland Machine Screw Co., Cleveland, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Garvin Machine Co., New York.
Gisholt Machine Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Machine Co., Springfield, Vt.
McCabe, J. J., New York.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey, Cleveland, O.

VALVES.
Consolidated Safety Valve Co., New York.
Jenkins Bros., New York.

VENTILATING FANS.
Backus Water Motor Co., Newark, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant & Co., B. F., Boston, Mass.

VENTILATORS.
Pancoast Ventilator Co., Philadelphia, Pa.

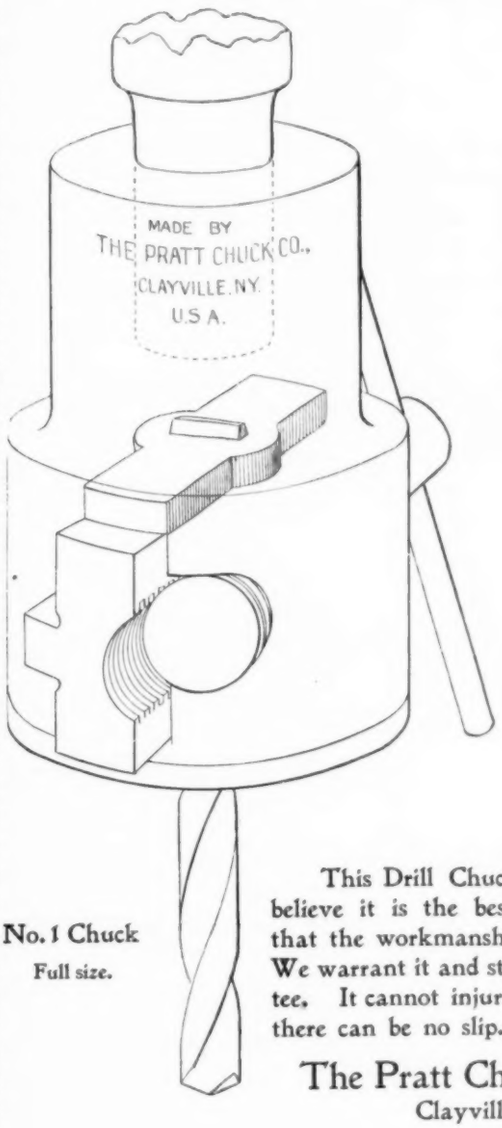
VISES.
Hill Clarke & Co., Boston, Mass.
McCabe J. J., New York
McFadden Co., Philadelphia, Pa.
Niles Tool Works Co., New York.
Strelinger & Co., Chas. A., Detroit, Mich.
Wyman & Gordon, Worcester, Mass.

WATER MOTORS.
Backus Water Motor Co., Newark, N. J.

WIRE MACHINERY.
Goodyear, S. W., Waterbury, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Waterbury Machine Co., Waterbury, Conn.

WOODWORKING MACHINERY.
Barnes Co., W. F. & John, Rockford, Ill.
J. A. Fay & Egan Co., Cincinnati O.
Pryibil, P., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

The Pratt Drill Chuck.



No. 1 Chuck
Full size.

O O O

Is well made of Steel, Hardened and Ground. Holds Straight or Taper Shanked Drills. A Perfect Friction, or Grip, Chuck, Having the Additional Advantage of its Positive Driver.

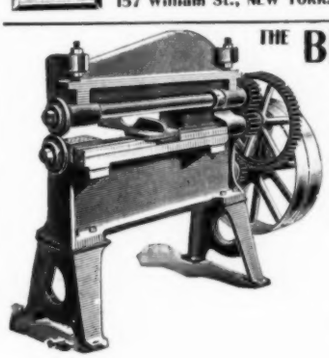
O O O

This Drill Chuck is our hobby, we believe it is the best in principle, and that the workmanship is equal to any. We warrant it and stand by the guarantee. It cannot injure Drill Shanks, and there can be no slip.

The Pratt Chuck Company,
Clayville, N. Y.

HEBER WELLS,
Pattern Letters.
For Iron and Brass Castings
Various Sizes and Styles....
157 William St., NEW YORK.

SPECIAL PRESSES AND DIES
FOR ALL KINDS OF BICYCLE WORK.
FERRACUTE MACHINE CO.
New Catalogue. BRIDGETON, N. J., U. S. A.



THE BETHLEHEM ROTARY SHEAR
Or SLITTER

Will Cut Plates one-quarter inch thick or less from one inch to thirty inches from edge—any length.

It will also CUT SHEET METAL in CURVES or CIRCLES

A Low-priced Machine which pays for itself in a few months.

FURTHER PARTICULARS ON APPLICATION.

BETHLEHEM FOUNDRY & MACHINE CO.
SOUTH BETHLEHEM, PA.

Two-Head, 37-inch

Boring and Turning Mill

Saves Time in Setting Work.

Two Tools on One Job.

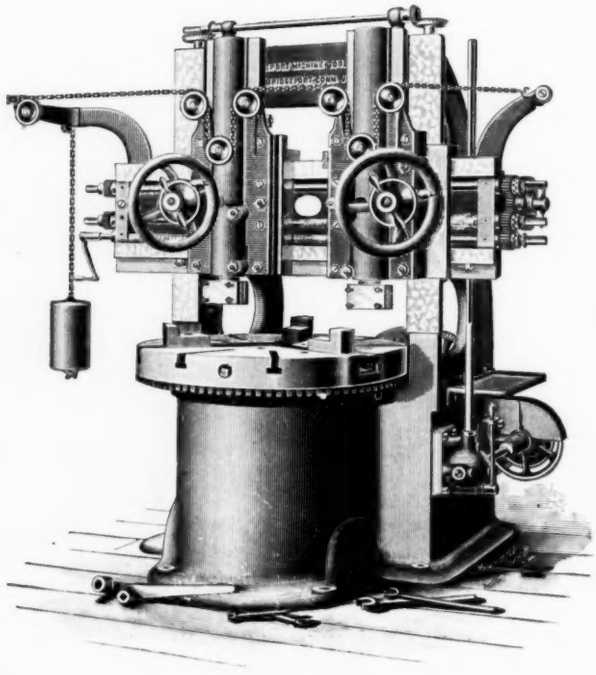
The Bullard Machine Tool Company,

Bridgeport, Conn.

Capacity, work 37 inches in diameter, 30 inches high.

Chuck has three jaws and is built into table, jaws easily removed.

Table extra heavy, geared for business, sixteen speeds.



Heads are entirely independent, both as to movement and feeds, set at any angle, tool bars have a movement of 19 inches. Either head can be brought to center for boring.

Feeds, positive, $\frac{1}{16}$ to $\frac{3}{8}$ of an inch horizontally, and $\frac{1}{64}$ to $\frac{1}{4}$ in in angular and vertical directions.

Countershaft has three pulleys, 20 inches diameter, 3 inch belt, should run 200 and 280 turns per minute. Weight, 8,800.

Self-contained—no Expensive Foundation required.

At the P. & R. Shops, Reading, Pa., this tool is saving 22 per cent. on work taken from planers, 34 per cent. on work taken from lathes, and 61 per cent. on work taken from slotters.

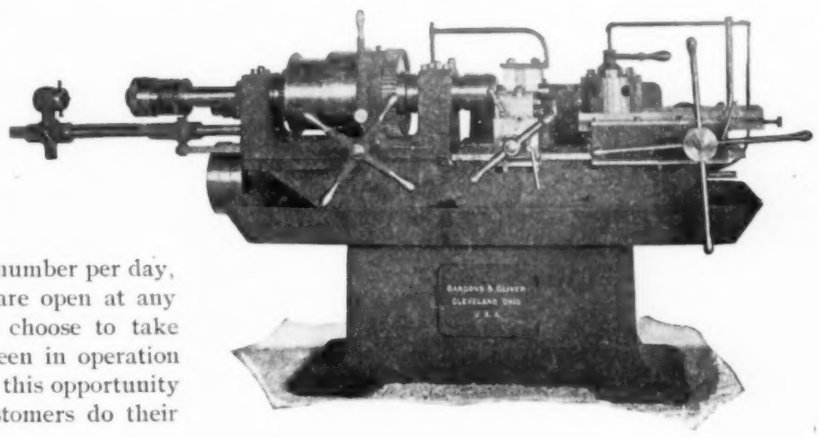
Our Specialty.---Tools for cheapening the cost of Bored, Turned, or Threaded Parts. We make a study of each case, and save you money. Catalog Free.

No. 5 TURRET LATHE

With Friction Back Gears, Wire Feed to take 2 in. round stock, Hub-forming Slide, Automatic Feed to Turret Slide and to Hub-forming Slide, Oil Pan, Oil Guard, Work Box, Oil Pump, Turret-oiling Device, Triple Friction Countershaft and Wrenches.

104 REAR HUBS IN TEN HOURS.

Since our advertisement appeared in this paper on November 12th, the Hub Machine, shown herewith, has again beaten our best previous record of 93 Rear Hubs. At the works of the Cleveland Hub Company it has made **104 Rear Hubs in Ten Hours,** drilled way through, finished and necked for the threads.



We do not **guarantee** any stated number per day, but the works of the above Company are open at any time to any of our friends whom we choose to take there. Seven Hub Machines can be seen in operation and can be timed by the visitor. With this opportunity given them we prefer to have our customers do their own guaranteeing.

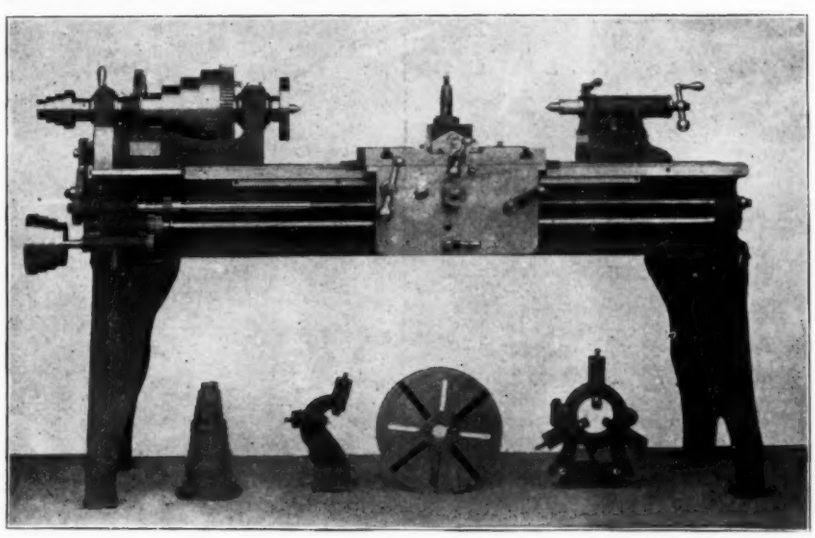
Our new Circular "A" is now ready for mailing; should be pleased to send to any one interested.

United States Shipping Weight, 3,800 lbs.
Foreign Shipping Weight, 4,600 lbs.

BARDONS & OLIVER, Cleveland, Ohio, U. S. A.

Agents for United States:
HILL, CLARKE & CO., BOSTON AND CHICAGO. J. J. McCABE, NEW YORK.

OUR NEW 14" LATHE.



HEAVY!
WELL BUILT!
PRACTICAL!

....

LARGE HOLLOW HAMMERED STEEL SPINDLE WITH GROUND JOURNALS.

....

BRONZE BEARINGS!
STEEL RACK!
STEEL PINIONS!

....

CARRIAGE HAS UNUSUAL LONG BEARING ON BED.

....

IF INTERESTED, WRITE US.

THE HAMILTON MACHINE TOOL CO.,

Zimmerman Avenue, - - - - - - Hamilton, Ohio.

The Arcade File Works

ESTABLISHED 1842.

WORKS: ANDERSON, INDIANA.

S. W. ALLERTON, President.
C. C. CLARKE, Secretary and Treasurer.
A. WEED, Vice President and General Manager.

Chicago Office and Warehouse: 118 Lake Street.

Manufacture an Improved Increment Cut File which has the approval and endorsement of the best M. E's. and mechanics in this and foreign countries.

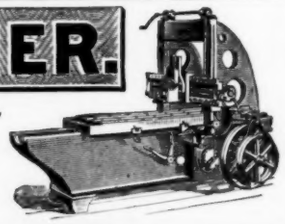
All Arcade Files have Weed's Improved Increment Cut, which insures sharp cutting and wearing qualities.

The Arcade File Works are the only File works in the world using natural gas throughout their plant. If you have any doubt about the superiority and better value of Arcade Files, send for our valuable souvenir—free to all M. E's.

NEW YORK OFFICE AND WAREHOUSE, 79 Reade and 97 Chambers Street,

ARCADE FILE WORKS.

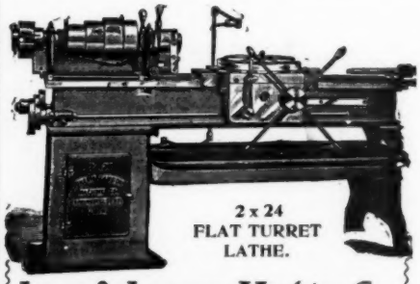
THE GRAY PLANER.



THE G. A. GRAY CO., CINCINNATI, O.

These Machines are sold by the following Agents:

J. A. FAY & EGAN CO., 34 South Canal Street, CHICAGO.
STRONG, CARLISLE & TURNEY CO., 193 Bank Street, CLEVELAND, O.
E. A. KINSEY & CO., 331 West Fourth Street, CINCINNATI, O.
THOS. K. CAREY & BROS. CO., 26 Light Street, BALTIMORE, MD.
J. J. McCABE, 14 Dey Street, NEW YORK CITY.
SCHUCHARDT & SCHUTTE, BERLIN, C., Germany, and VIENNA, Austria.
CHAS. CHURCHILL & CO., LTD., LONDON and BIRMINGHAM, England.



2 x 24
FLAT TURRET
LATHE.

Jones & Lamson Machine Co.
Springfield, Vt., U. S. A.

SOLE BUILDER OF THE

Flat Turret Lathe.

FOREIGN REPRESENTATIVES:
M. Koyemann, Charlottenstrasse 112, Dusseldorf, Germany.
Adolphe Janssens, 16 Place de la Republique, Paris, France.
Charles Churchill & Co., 9-15 Leonard St., Finsbury, London, E.C., and 6 Albert St., Birmingham, Eng.
Henry Kelley & Co., 26 Pall Mall, Manchester, Eng.

SEND FOR ILLUSTRATED CATALOGUE.

NICHOLSON FILE CO.

Our PAST RECORD the best GUARANTEE for the FUTURE.

BOX 188, PROVIDENCE, R. I., U. S. A.

How to Save Money in Blacksmith Shops.

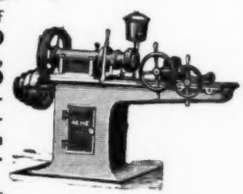
By ORVILLE H. REYNOLDS.

...ILLUSTRATED pamphlet showing operations done by dies and formers by means of bulldozer and helve hammers. Ought to be in the hands of every foreman blacksmith. Published by LOCOMOTIVE ENGINEERING,
Price 25 cents. 256 Broadway, New York.

THE ACME Machinery Co.

CLEVELAND, O.

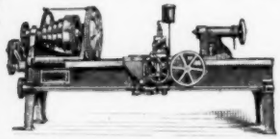
MANUFACTURERS OF ACME BOLT AND RIVET HEADERS, ACME SINGLE AND DOUBLE AUTOMATIC BOLT CUTTERS, cutting from 1-8 in. to 6 in. diam.
ALSO SEPARATE HEADS AND DIES.

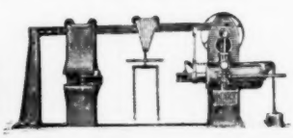


William Sellers & Co. Incorp. PHILADELPHIA.

HAVE YOU EXAMINED?

THE NEW TOOL GRINDER, No. 2?
THE CENTRIFUGAL SAND MIXER?
THE VICARS' MECHANICAL STOKER?





ENTIRELY AUTOMATIC

GEAR CUTTER

AND PATENT DUPLEX CUTTERS.

GOULD & EBERHARDT, Newark, N. J.

JOHN LANG & SONS, JOHNSTONE, SCOTLAND,
Sole Agents on Gear Cutters for Great Britain.
SCHUCHARDT & SCHUTTE, GENERAL AGENTS,
Berlin, Germany; 17 Breitegasse, Vienna, Austria.

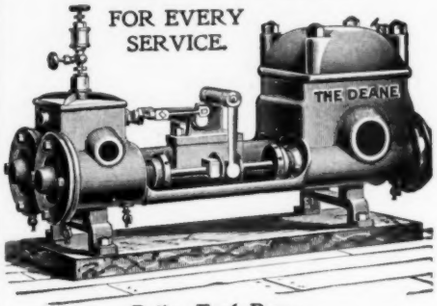
EXPORT TRADE A SPECIALTY.

ST. LOUIS, MO.

The Deane OF HOLYOKE.

STEAM PUMPS

FOR EVERY SERVICE.



Boiler Feed Pump.

DEANE STEAM PUMP CO.

HOLYOKE, MASS.

New York. Boston. Chicago.

GRANT GEARS

GEAR WHEELS CUTTING

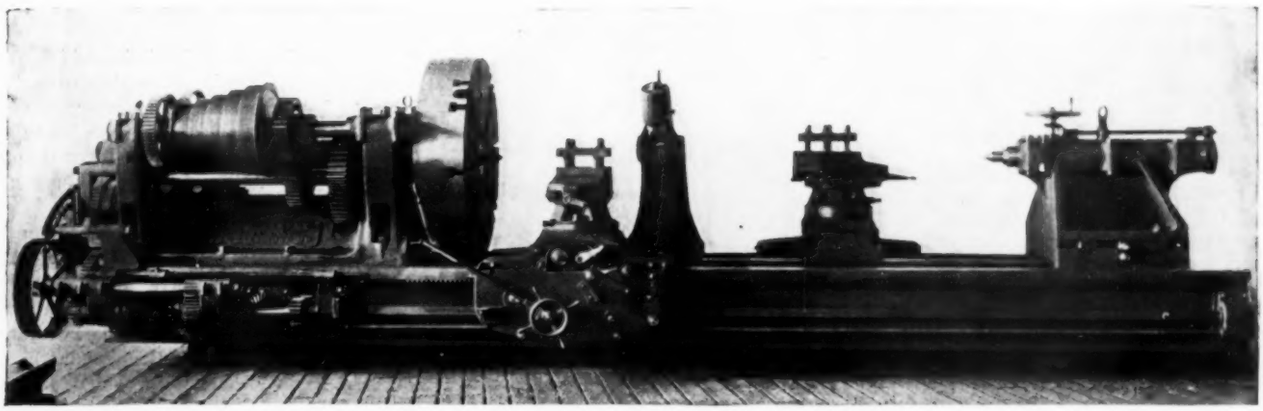
Grant Gear Works,
125 South 11th Street, PHILADELPHIA.
6 Portland Street, BOSTON.
86 Seneca Street, CLEVELAND.

Send for Catalog.

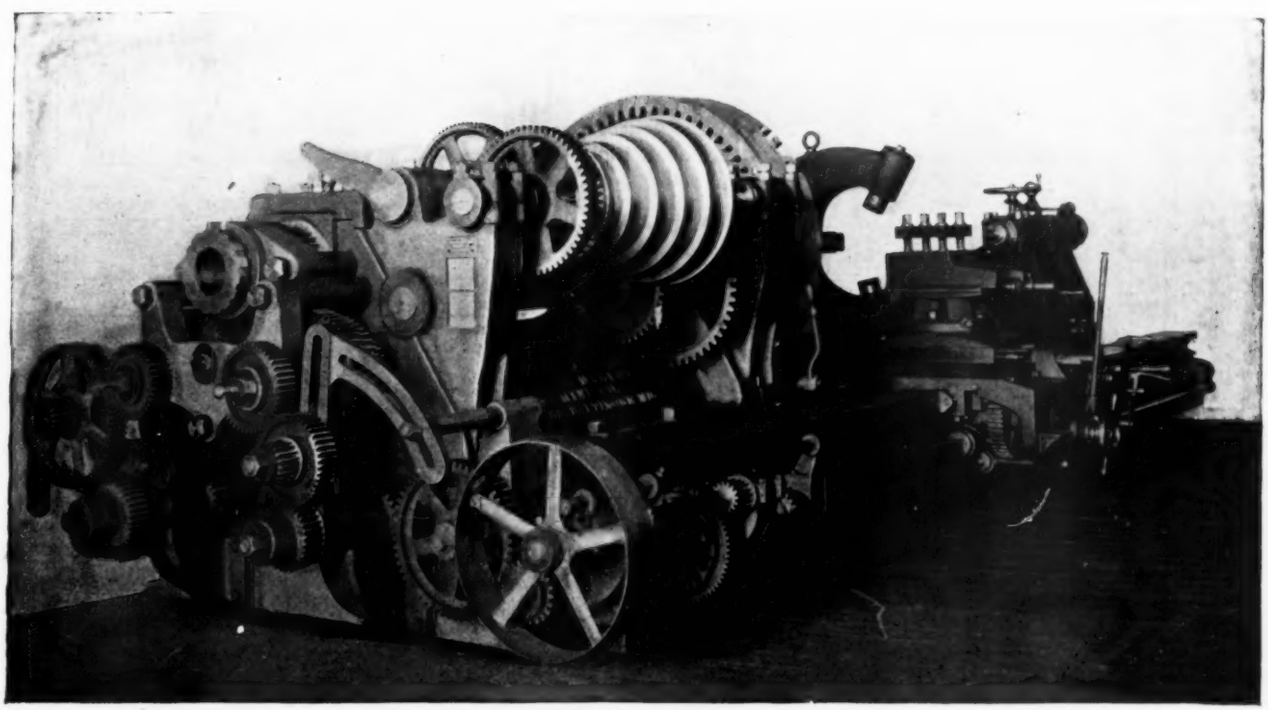
AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

VOLUME 19. NEW YORK, THURSDAY, DECEMBER 10, 1896. NUMBER 50.



57-INCH BORING AND TURNING LATHE.



57-INCH BORING AND TURNING LATHE.

A 57-Inch Lathe.

We are enabled to bring to the notice of our readers an interesting lathe recently built by the Detrick & Harvey Company, of Baltimore, for the Union Iron Works, San Francisco. The lathe is built for heavy work and for accomplishing it as rapidly as possible, and to this end is arranged with two entirely independent rests for carrying cutting tools, and it has also the means for operating a boring bar at the same time.

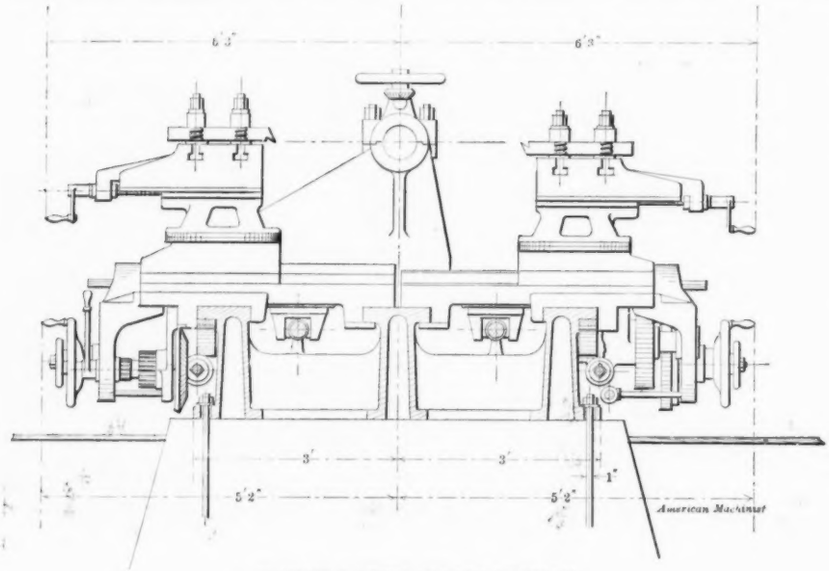
The lathe swings 57 inches over the shears and 42 inches over the carriages, and takes 12 feet between centers. The bed

consists of three heavy longitudinal girders rigidly connected at suitable points. The two carriages each bear only on one-half of the center girder, or a little less than half, so that they pass each other without interfering. Each carriage is operated by its own lead screw, independent of the other as to both speed and direction of movement. The foot stock bears only on the back and center girders, so that the front part of the front carriage will pass it, and the front tool may be brought to work close to the foot-stock if necessary.

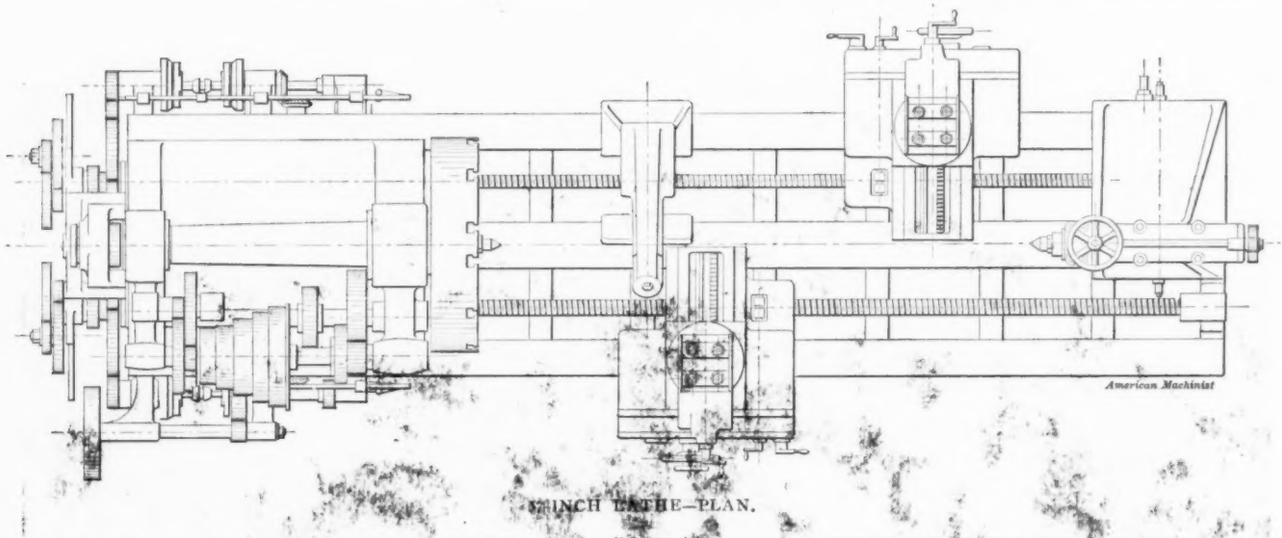
The tail spindle, which is round, is held by a cap which may be removed, when the spindle may be slipped out and a boring bar of the same diameter, or with suitable bushes, may be clamped in its place, the other end of the bar extending into a bush in the live spindle, which is hollow its entire length. The foot-stock is fed along by a nut which engages with the back tool carriage lead screw. The tail spindle screw, when in place, is operated by the horizontal hand-wheel on the front end of the foot-stock, a small spindle and suitable gearing connecting it with the back end of the screw. The foot-stock is moved along the bed by hand, by means of a rack and pinion; it may be set over laterally for turning tapers, or other service.

The steady rest of this lathe, which, on account of its use in connection with the boring bar is an important feature, is unusually heavy. It has three jaws, and the top is removable for putting in or lifting out the work. The base of the rest is made to clear the front carriage.

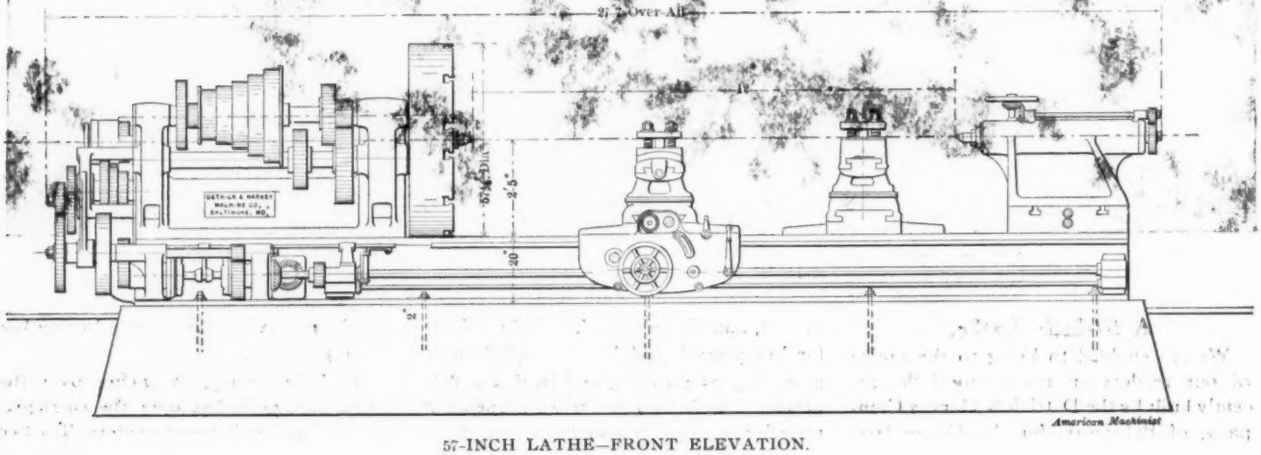
The live spindle carries a deep and heavy face plate with tee slots and bolt holes and with ways for four sliding jaws and operating screws. The gear and cone changes give twenty speeds without changing the speed of the countershaft. The hollow spindle is provided at the front end with a bushing for the boring



57-INCH LATHE—CROSS-SECTION.



57-INCH LATHE—PLAN.



57-INCH LATHE—FRONT ELEVATION.

bar, and with another bushing for the live center.

Three speeds for the main lead screws are provided without changing the gears, while by means of suitable gears the range of feeds may be extended as desired. Both the carriages and tool slides have full automatic feeds in all directions, and either carriage may also be run along by power in either direction at the rate of ten feet per minute, thus enabling the operator to locate the tool rapidly without running away to either end of the lathe. The cross and angular feeds, and this quick traverse spoken of, receive the power for their operation from the square shaft running through each carriage and extending the whole length of the lathe. At the head of the lathe, outside of each square shaft and geared to it, is a short shaft upon which are two friction wheels facing each other, and with a sliding friction clutch between them. This clutch is operated from the carriage by means of the small horizontal spindle seen under the square shaft. A half turn of this spindle, transmitted through the small miter gears, works a little crank connected with a sliding bar which carries the clutch-operating fork. The outer friction wheel, both at the front and back of the lathe, is connected with the main train of feed gears driven by the lathe spindle, and gives the proper speed for the usual cross or angular feeds, while the inner friction wheel moves much faster, being driven by the independent pulley at the head of the lathe, and is engaged only when the quick traverse of the carriage is required. These quick traverse friction wheels are connected by the larger miter gears and a cross-shaft running under the head-stock. The two half-tones and the plan, elevation and cross-section give a good idea of the lathe and its details.

▲ ▲ ▲

Development of Gas Engines Abroad.

Consul-General Frank H. Mason, at Frankfort, Germany, has transmitted to the State Department an interesting report in which he says:

"When, a few years ago, electric lighting was shown to be a technical and economic possibility, many well-informed persons predicted that as the use of electricity increased, the consumption of gas and petroleum for lighting purposes would proportionately diminish, and the ultimate ruin of the gas interests, especially in the larger cities, was confidently foretold. Neither of these results has been realized, nor is there any likelihood that they will be.

"The prophets of a dozen years ago could not, of course, foresee the important improvements that would soon be made through the use of incandescent burners, nor the wide adoption of gas and petroleum engines.

"There is, perhaps, no more brilliant chapter in the record of mechanical progress than that which records the successive inventions by which the efficiency of gas motors has been raised, step by step, to the high economic standard which rules to-day. The first recorded tests in this field were made by Tresca, in March, 1871, who, with the primitive Lenoir motor, the first of the so-called 'internal combustion' engines that was applied to actual work, found that its efficiency, with a combustion of 96 cubic feet of gas, was but 0.04 per cent. In our day there are hundreds of gas engines which, with a consumption of 16 to 18 feet of gas per horse-power, yield a mechanical efficiency of 80 to 85 per cent., thus equaling steam engines of the very highest and most perfected type.

"In the block stations of the City Electrical Works at Frankfort, there are now at work two single-cylinder gas engines of 35 horse-power each, built by Gebruder Korting. These machines have been subjected to the most exhaustive tests for the purpose of establishing the latest and highest standard of efficiency upon which to base comparisons, with the result that the gas consumption per horse-power per hour is as low as 17.24 cubic feet with the gas at 64 degrees Fahr., and 16.81 feet with gas at freezing point (32 degrees Fahr.).

"In addition to their greater economy in fuel, as compared with steam engines, these motors have the important advantages of occupying small space, direct coupling, with elimination of belts and gearing, smaller circumferential speed of armatures, the avoidance of feed-water apparatus, coal storage with its dirt and smoke, and the greater general readiness of the whole plant for any emergency which may arise from the varying requirements of currents produced.

"In the country where every detail of engineering and mechanics is so carefully studied as in Germany, especially in all that relates to the economy of service, it is certainly of the highest significance that, in electric lighting, the best German experts now give their unqualified verdict in favor of the 'block system'; that is, to small independent stations, worked by gas engines, instead of larger central stations, with dynamos driven by steam."

▲ ▲ ▲

Metallic Lathing.

Modern building methods and materials seem to be undergoing a very complete change, even to the smallest details. The familiar wooden laths are now being rapidly driven out of use. Metallic lathing makes the walls stronger and the plastering less liable to crack. The first metal lath was a thin strip of sheet metal with the edges turned to give it stiffness. Then they were rolled with ribs as well as the turned edges. Perforated sheet iron with ragged punctures that would hold the mortar came later, and then wire netting lathing was introduced. The wire netting, strengthened with ribs of coarser wire, is used for partitions and also for concrete floors. The industry has led to scores of patents, most of which are for various styles of perforating, twisting, expanding or variously distorting or extending the original flat surfaces. The sales of one company manufacturing this material are said to run considerably above a million dollars a year.

▲ ▲ ▲

Keys and Keyways for Fly-Wheels.

In the discussion of a valuable paper upon "Break-downs of Stationary Engines," before the British Institution of Mechanical Engineers, some interesting remarks were made upon the fitting of keyways. The paper referred to, which gave a long list of accidents, with the cause of each, stated that among the accidents to fly-wheels five were caused by cracks in bosses due to driving the keys. In four of these cases the fractures started from the corners of rectangular keyways, and the other between the keyways. A

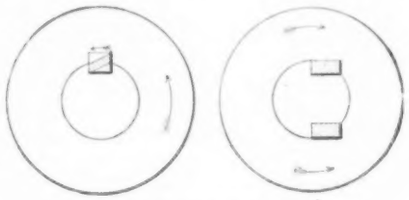


Fig. 1 *American Machinist* Fig. 2

KEYING FLY-WHEELS.

speaker advocated the practice, which we had supposed to be now obsolete, of hanging wheels on four or more broad keys with plenty of substance in them, bedded upon flats in the shaft, and driven alternately from opposite sides. The corners of the key-seats in the boss should be rounded and the spaces between the keys filled with hardwood and steel wedges. The speaker sketched an ordinary key of square section, Fig. 1, showing its objectionable features. If driven too tight it tends to burst the boss, and if loose it rolls over more or less, as indicated by the arrow, and only the shaded part did useful work. Fig. 2 shows another mode of keying adopted by the speaker. It was effective in either backward or forward rotation; but as a matter of security, a second key on the opposite side of the shaft was added. This system of keying was also well spoken of as a feather for sliding motion. The sketches are taken from our esteemed contemporary, "Engineering," London.

The suggestion of the second key opposite the two in the last sketch, and other remarks in the course of the discussion, indicate that English engineers place more dependence upon the key surfaces and less upon the cylindrical surfaces than we do and it is difficult to believe that either security or truth are best assured by their methods.

A Diagram for Determining Diameters of Solid Round Shafts Subject to Bending and Twisting, and Arrangement of Drawing-Room Bluebook.

BY HENRY HESS.

In a recent number there was given a diagram by the writer for finding the diameters of solid shafts, and their hollow equivalents for any bending or twisting moment, or the converse. In that diagram the finding of the proper diameter of solid shaft involved a somewhat tortuous process of tracing between reference lines and scales, and it was not accurate for shafts much below 5 inches. Since then the writer has devised a more direct method of much wider range, which may prove of interest and use to others.

The diagram shown is an exact reproduction of page 433 of a bluebook of standards, etc., in use in the drawing office of the Superintending Constructors for the United States Navy at Newport News, Va., where the Chief Constructor, Mr. Woodward, and his Chief Draftsman, Mr. Stoerer, early recognized the value of such a bluebook and allotted the task of arrangement to the writer. The ordinary business-letter form was adopted, because it allowed the insertion of matter prepared on the typewriter on standard notepaper. Then, to admit of ready additions as new or desirable matter suggested itself, the ordinary McGill fasteners were adopted as binders, and passed through holes punched at the sheet-top through circles drawn on the sheet. A stiff cardboard back and blueprint title-cover were added, together with an alphabetical index, liberally cross-referenced. On the edge of each sheet was given a sheet number, each successive one somewhat lower down, so that any number could be seen and turned to at once, much after the manner of some dictionaries. So far, two columns of such reference figures have been needed, each giving room for fifty numbers. All of which can be readily seen from the sample given, a look at which will bring us back again to our mutton.

The directions for use are given on the diagram itself, and need not therefore be repeated here, but for further clearness an example is given: Let the bending moment be 90,000 inch pounds, and the greatest fibre stress allowed 5,000 pounds per square inch. To find the shaft diameter, follow the diagonal marked 90,000 to the 5,000-pound vertical, and refer the intersection to Scale No. 1, where read 5 1/16 inches shaft diameter. For a moment of 900,000 inch-pounds, cut off one cipher giving 90,000, and proceed as before, but referring to Scale No. 2, where find 12 1/4 inches shaft diameter. Similarly for a moment of 9,000,000 inch-pounds, two zeros are cut out and the third scale is employed, giving a shaft diameter of 26 3/8 inches.

As to accuracy, without resorting to interpolations on the scale: For bending moments from 10 to 400,000 inch-pounds, diameters are read to the nearest sixteenth of an inch; from 400,000 to 4,000,000 inch-pounds, to the nearest eighth; and from 4,000,000 to 40,000,000, to the nearest quarter inch.

The formula employed is the general one for solid round shafts:

$$M = \frac{\pi}{16} f d^3;$$

in which

M = twisting movement in inch-pounds,
f = greatest fibre stress in pounds per square inch,
d = draft diameter in inches.

As formulæ of this general type, involving a constant factor and one raised to a power, are very frequently met with, this method for embodying them in the shape of a straight-line diagram that is easily and quickly constructed may prove interesting and useful, and is therefore described. In the usual form on square-ruled cross-section paper, with terms f and d as vertical and horizontal scales of equal divisions, M is given in the shape of a curve that is plotted by calculating a series of values and connecting them by a smooth line. Needless to say that when a series of such curves for a series of values of f is to be drawn, the labor of calculating and plotting becomes too great for the adoption of this method of easing subsequent work. With the form here given for each M line, but one point needs to be calculated and plotted, and through this a diagonal is drawn to the origin at 0.

In constructing, choose values of d and f likely to be in the neighborhood of those that will be most frequently employed in subsequent work; draw a diagonal from the 0 at an angle of 45 degrees, to represent the M corresponding to the chosen values of d and f. Forty-five degrees is employed because that angle gives the most accurate readings, which will therefore always be had for that portion of the diagram most generally useful hereafter. Divide the d scale into equal parts. Through the intersection of the d ordinate with the diagonal, draw an f ordinate at right angles to the d ordinate. Then with the previous value of M and a new value of d, calculate a new f, and through the intersection of d and M draw the line for this second value of f. Proceed similarly for as many values of f as may be desirable. Then with any given value of f and a new value of M, calculate d and plot the new M diagonal by drawing it from the origin through the intersection of the f employed and the d calculated. Proceed similarly to lay down as many diagonals as are likely to prove useful. An inspection of the diagram shows that whereas the d scale is one of equal divisions, that for f shows decreasing increments for equal increases in values of f, and that similarly the angles embraced between successive equal steps of M become smaller as M becomes larger.

A diagram such as this possesses not only the advantage of easy construction over the curve method, but is also more accurate in reading, since accuracy depends upon the angle at which the diagonal or curve intersects the ordinates, being a maximum when the angle formed with both right-angled ordinates is equal; that is, at 45 degrees. As shown, this angle can be adopted for the most usual value of M, while a curve for this same value in a diagram of like size flattens out very quickly. Even those diagonals representing values near the limits intersect at angles as favorable as those given by a considerable portion of the most accurate curve. As a result, such a diagram, covering a considerable range with all desirable accuracy, can be made to occupy dimensions sufficiently small to permit its insertion into the usual engineer's pocket book. For like use the curve method could be made to give either accuracy for a small range, or large range with considerable error; but never the desirable combination of accuracy and large range with small and handy size.

Newport News, Va.

▲ ▲ ▲

Credit Where Credit is Due.

The Chicago house of the Crescent Steel Company has recently issued a little folder made to inclose with letters and intended to help in the educational work connected with the proper use of steel. This folder contains a short article designed to impress upon steel users the necessity of having a steel not only adapted to its purpose in respect of quality, but also in respect to the proportion of carbon contained. The article is credited to the "Iron and Coal Trades Review." In thus crediting it, the Crescent Steel Company had, of course, no other intention than to give credit where credit is due; but the fact is that the "Iron and Coal Trades Review" had reprinted the article from an editorial of our own without credit, and we have since seen it reprinted in a number of other journals, credited honestly to the same source. It is a particularly annoying phase of this practice of appropriating our matter without credit, that the appropriators are afterward quite often given credit by those who are not in the habit of appropriating others' work without credit, they thinking, of course, that they are taking the matter from its original source.

There is a point at which patience ceases to be a virtue in this matter, as well as in other affairs. If matter appearing in this journal is worth reprinting, it is worth crediting to us, and we say that any contemporary of ours who reprints from our columns, intentionally omitting such credit as will indicate the source of the matter, is not playing fair, and that we propose to do what we can to protect

DIAGRAM FOR DETERMINING DIAMETERS OF SHAFTS, SUBJECT TO BENDING OR TWISTING.

Scale No. 3 - Diameters in Inches.
Scale No. 2 - Diameters in Inches.
DIRECTIONS FOR USING.
1 For Moments between 4,000,000 and 40,000,000 inch pounds. Point off two decimal places and proceed, reading SCALE No. 3, TO THE LEFT.
2 For Moments between 400,000 and 4,000,000 inch pounds. Point off one decimal place and proceed as before only reading on SCALE No. 2, TO THE LEFT.
3 By moving up or down the Fiber Stress Line till value is approximately spotted; select horizontal line nearest this spot and follow to RIGHT, reading required diameter on SCALE No. 1.
4 For Moments up to 400,000 inch pounds. Select diagonal line having a value nearest to given moment, follow this diagonal till it intersects Line of Allowed Maximum Fiber Stress; if diagonal does not give exact value of moment, interpolate.
Vertical lines represent maximum fiber stress in pounds per square inch.
20,000
17,500
15,000
12,500
10,000
7,500
5,000
2,500
1,000
Scale No. 1 - Diameters in Inches.

NOTE: — The figures indicated on radial lines are for bending moments in inch pounds. — To use for twisting, take one-half the given twisting moment and use diagram as in case of bending.

T 43

American Machinist

ourselves from such appropriation in the future. And we say further that injecting into a stolen article such expressions as "a writer says," "observes a writer," etc., without giving proper and full credit, is proof of a deliberate intention to steal.

▲ ▲ ▲

Electrical Speed Indicator.

We present herewith illustrations of a revolution indicator which is based upon an entirely new principle. A revolution indicator is radically different from a revolution counter, in that it shows by the position of a pointer on the dial the actual rate of speed at any moment, instead of counting the number of turns in a given time.

The machine is electrical in its character, and is based upon the fact that the voltage generated by a dynamo varies with the speed, and hence the voltage may be made an index of the speed, and a voltmeter properly graduated may be made to show at once the speed at which the generator is turning. In order to accomplish this it is, of course, necessary that the resistance which the current works through shall not vary, which naturally follows in the present machine, as it has no outside work to do.

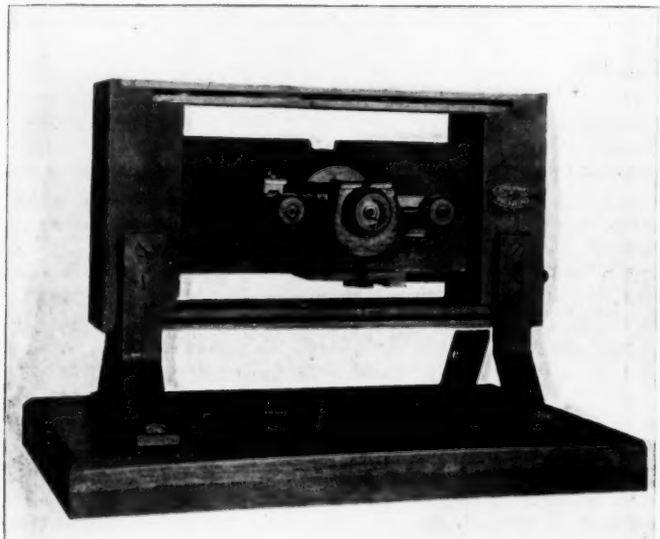


Fig. 1.

Fig. 2.

ELECTRICAL SPEED INDICATOR.

The generator is shown in Fig. 1, and is not a dynamo as that term is restricted, but a magneto machine; that is, it has permanent magnets for its fields, and not electro magents excited by itself. This machine is belted to the engine or other shaft whose speed is to be indicated, and from it the wires lead to the indicator dial, shown in Fig. 2, which is a simple voltmeter, but graduated to read to revolutions instead of volts.

In order that the voltage and speed may be proportional, the field must be of constant strength, while, of course, large output of current is not required, and this constant field must be maintained without loss with lapse of time. To secure this, the magnets are made of a special grade of steel, which the manufacturers inform us is the only one known to them having this property. It is, moreover, subjected to a special treatment, which is not a matter for publication at the present time. The armature is of the ironclad type, which adds to its efficiency as a keeper, and so assists in preventing deterioration in the magnetic field strength. The manufacturers inform us that, as a matter of fact, machines which are two years old show variations which are practically negligible. Means of adjusting the machine, should variations occur, are provided in an adjustable shunt in the air gap, which will be seen attached to the bottom of the right-hand pole piece. The dial indicators are also capable of adjustment and correction, both for zero and for deflection. It will, of course, be understood that these adjustments are simple matters, based on comparing the readings of the indicator with those obtained from an ordinary revolution counter.

One of the features of this apparatus, which is not shared by any mechanical indicator, is that as many dials as may be wanted may be connected to the same generator and be located at different and widely separated places. In an industrial works or mill, for example, dials may be placed in the engine room, superintendent's office and wherever else desired.

A field in which the indicator has met a "long-felt want," is in its application to marine engines, for which, in fact, the indicator shown is intended. It will be seen that not only does it indicate the speed, but also the direction of turning, as a reversal of the generator reverses the direction of the current generated, which shows at once on the dial by the pointer moving to the other end of the scale. In marine use, it is customary to have a dial attached to the engine, with duplicates in the engineer's room, captain's room and on the bridge.

One of the effects of the appartus in marine work is to enable the two engines of a twin screw ship to be kept at the same speed, since having the two dials before one, it is possible to adjust the engines to perfect synchronism, even when located in separate compartments and out of sight of one another. This enables the rudder to be kept amidship on a straight course, and avoids the drag due to the rudder being at an angle, as it must be if the engines are not exactly in time. One of the Atlantic greyhounds claims to save at least two hours in a trip across in consequence of being able to thus regulate the speed of the engines and keep the rudder central.

We understand that the apparatus is applied to the ships of the American line, to some of the new ships of the Navy, to several yachts and to other miscellaneous ships. It is made by the Electro-Dynamic Company, of 224 Chestnut street, Philadelphia.

▲ ▲ ▲

The Bradford (England) "Daily Argus" expresses the hope that the application of our brutal and senseless principle of "To the victor belongs the spoils" will not result in retiring our American Consul at Bradford, Mr. Claude Meeker, who has proven himself an efficient and popular representative of this country, ever ready not only to discharge his official duty, but to go far beyond it in advancing the commercial and other interests of his countrymen.

Letters from Practical Men.

Underground Trolley Lines.

Editor American Machinist:

On page 32 of your issue of October 29th, in speaking of the compressed air cars on the Lenox avenue line, you say this "is the only line in the United States operated by the underground trolley." This is incorrect. The Metropolitan Railway Company of Washington, D. C., operates its system by underground trolley and has done so for some time; just how long I do not know, but not less than six months. This system includes what is commonly spoken of as the F street line and the Ninth street line. These cars have given satisfactory service, especially so after the September storm, when they ran uninterruptedly while electric lights and everything else depending on overhead lines were stopped. If my memory serves me right, there is a short underground trolley line in Chicago. Of this I am not sure, though.

H. L. Reynolds.

▲ ▲ ▲

Power Tests Versus Time Tests—Electric Motor for Driving Machine Tools—Speed of Planers.

Editor American Machinist:

I have been greatly interested in the various communications on the above subject which have recently appeared in your columns, but it seems to me that Mr. Tecumseh Swift does not grasp the import of Mr. Hoffman's paper describing the Flather hydraulic dynamometer, which was abstracted in your columns of August 20th.

By referring to the article in question it will be noted that the action of the machine is described and examples of cards are given to show, as Mr. Hoffman states, "how readily the recording device responds to any slight change in the power transmitted."

The paper did not attempt to show how much power was required to drive machine tools, but was a description of a machine intended to measure power. A careful examination of Mr. Hoffman's paper, as it appeared in the "American Machinist," fails to disclose any reference to the power required to drive any of the machines for which the cards were given.

Mr. Swift says: "If the article carried any hint to anybody of how any machine could be made to do more work, or whether any machine would do more or less work, under any change of conditions, I have failed to find it." By referring to Fig. 8, page 785, a condition of affairs may be noted which indicates, incidentally, that a lesser or greater amount of work can be done in a given lathe by increasing or decreasing the pressure and lubrication at the tail-stock center. As far as the work done is concerned the latter may give no indication of the power required to drive it, the belt may not slip nor the center squeak, and yet, as shown by myself in the "American Machinist" of April 23, 1891, the power required to turn off a given amount of metal may be three times as great in one case as in another.

Power may not be worth anything, or, as Mr. Swift puts it, "it is often so cheap in comparison with other items that it is not even worth saving," but my observation and experience lead me to think that the tendency of engineers for many years past has been to increase the output with a minimum expenditure for power. Especially is this noticeable in the methods of power transmission. In the average machine shop the transmission loss is about forty per cent. when all the machines are in operation, but in most instances it will be found that all the machines are in operation only about half the time under ordinary conditions as we find them, while the shafting loss is practically constant; there is, therefore, only about forty per cent. of the power of the engine which is converted into useful work at the machine. Now that this loss is becoming recognized, greater attention is being paid to its elimination, and we find various expedients adopted. Among these are better arrangements for lubricating the shafting and keeping it in line; the use of hollow and consequently lighter shafting; higher speeds and lighter pulleys; greater care is given to the belting; roller bearings are being introduced; the subdivision of power by using smaller units is receiving its share of attention; and now that the economy of the electric motor has been demonstrated, we shall expect to see it used more and more. All these indicate that manufacturers consider power worth saving, but it was owing to the various methods in use for measuring power that they realized the extent of this loss.

The object of a dynamometer test, however, is not to save power, but to ascertain how much is required to operate a given machine. Incidentally, many things are shown by its use which may lead to a greater output and increased economy.

Every intelligent manufacturer will admit Mr. Swift's proposition, that it would generally be a very profitable investment if we could increase the efficiency of the men ten per cent. by doubling the power used. Perhaps, if we double the power, it would be better to consider the increase in efficiency as that of the machine instead of the operator, for in many cases the efficiency of the man could be greatly increased without an increment of power applied to the machine. Proper shape and condition of tools, suitable cutting speeds, feed proportioned to the work, sufficient lubrication, driving belts and countershaft in good order, machine in good order, and a laudable desire to pile up chips—these may all tend to increase the efficiency, while the power required to drive may not vary appreciably.

The best shape of tool to use in any given case has been fairly well determined by measuring the power required to produce a given amount of chips in a given time with tools having different forms and different degrees of rake and clearance, and the progressive manufacturer is one who increases the efficiency of man and machine by using some form of special tool grinder by which the tools are kept to the best form.

Mr. Swift is astonished that in these days we hear so much about Power tests and so little about Time tests. The reason we hear so much about power measurement of machine tools is that there is a pretty general desire to know how much power is required to operate these tools under varying conditions. Probably, the principal object of the tests is to furnish information from which an independent motor may be selected to run the machine or group of machines. While the manufacturer may agree entirely with Mr. Swift in admitting the desirability of doubling his power if thereby a ten per cent. increase in output may be obtained, yet the important question is to ascertain how much power double an unknown quantity amounts to.

It is the function of the dynamometer to ascertain the unknown amount, which we can double if desired. But in carrying out a series of tests on any machine, the average power required to drive is of as much importance as the maximum; for with the usual group system of motors, in which a group of machines are belted from a short shaft driven by a single motor, the motor capacity need not be the equivalent of the total maximum power required to operate the several machines in the group, but may be taken at some value less than the total, depending upon the number of machines, and the average period of operation. On the other hand, in independently driven machines, the motor capacity must not only equal the maximum power required to drive the machine at full load, but in certain machines, as planers, for instance, it must be capable of exerting a greatly increased momentary torque, due to the increased load at reversal.

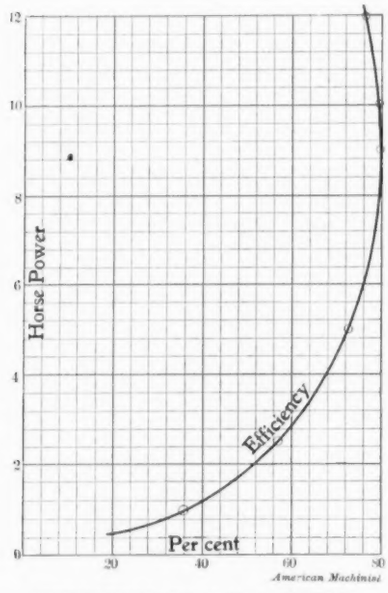
When observations are made of the voltage and current supplied to an electric motor, the latter becomes a dynamometer, and from the watts supplied to the motor it can readily be ascertained how much power is required to run the machine and motor. By calibrating the motor at different loads, which can be done by means of a transmission dynamometer, its efficiencies can be determined, from which the power required to drive any machine can be obtained from the motor itself. Thus, a certain 10 horsepower motor at 220 volts has an efficiency of 79 per cent. at full load, and 80 per cent. at a little less than full load, fall-

ing off to 73 per cent. at half load, 56 per cent. at quarter load, 35 per cent. at one-tenth load, and 76 per cent. at one-fifth overload. From these values a curve may be plotted which will give the efficiency for any intermediate value, as shown in Fig. 1.

Now, if we belt this motor to the countershaft of a drill press it may require 4.1 amperes to run it under given conditions; that is, there is delivered to the motor:

$$\frac{4.1 \text{ amperes} \times 220 \text{ volts}}{746} = 1.2 \text{ horse-power.}$$

But the efficiency of the motor at this load is only 40 per cent.; therefore, instead of the drill press requiring 1.2



EFFICIENCY OF 10 H.-P. MOTOR.

horse-power under these conditions, only 0.48 horse-power is delivered to the countershaft of the drill press. If this drill press were to be one of a group of several machines, ½ horse-power would be ample to allow for its operation under the given conditions, assuming that the motor driving the group was so proportioned to the work that its efficiency would not greatly vary from that at full load.

There should be no comparison between Power tests and Time tests. They have no connection whatever. As I understand the time test, it is simply a matter of getting a maximum amount of good work out of a machine without reference to power.

Some tools are kept in the shop for the good they have done, and anything like a large output is impossible with many such machines. The time element in this relation is worth considering. When a tool has become so old that it has to be nursed and treated with respect in order to get any work out of it, then is the time to "strain it through a cupola" and put in a good stiff modern machine. This process has been going on ever since machine shops were built.

Probably one of the best evidences of results in time tests is the pay of the piece-worker; if by increasing the cutting speed of a machine more work may be turned out, we shall find that such machine will be run to its limit by the piece-worker. If more work can be accomplished by slow-cutting speed and coarse feeds, the man at the machine will find this out. The capacity of a good machine is usually limited by the belt velocity and pull, and so long as it will do the work, no thought is given to the quantity of power used. If the machine is stiff enough to stand up to the work, its power may be increased by increasing the belt speed, but with modern tools we usually find these matters taken care of by the machine tool builder. If you want a machine which will do more work, a good plan is to get a larger machine or a special tool for your particular work.

Regarding the speeding up of planers referred to by Mr. W. O. Webber, it depends pretty much upon the quality of the iron. Several years ago I noticed some 30-inch planers upon the third or fourth floor of the Garvin Machine Company's shop, which were running at 25 feet per minute cutting speed, 75 feet return; the work was soft gray iron, and the machine ran well without vibration or noise notwithstanding there was no foundation. Some time later I speeded up a 36-inch planer, which was running at 15 feet per minute, to 24 feet per minute; but the quantity of work done fell off perceptibly, and the speed was dropped down to 18 feet. The castings were hard, and the higher speed necessitated a finer feed; even then the tools would not hold their edge. Ninety feet return is a fairly high speed; but Mr. George Gray had a planer in use in his shops in Cincinnati, a few years ago, which was reversing, at the time I saw it, at 120 feet per minute; the ratio forward to return being six to one.

J. J. FLATHER.

▲ ▲ ▲

Centering and Shaft Turning—Accurate Surfaces on Wood.

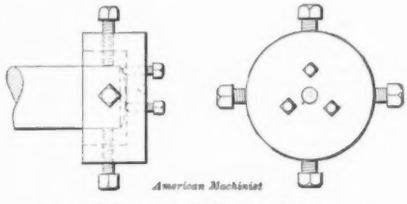
Editor American Machinist:

In the October 8th issue of the "American Machinist," Mr. Swift describes a good method of centering and turning a shaft; but many machinists have to turn shafts on lathes which have no hole through the spindle, and therefore cannot use his ingenious "back-action live-spindle drill." For their benefit the following method is given:

A good independent-jaw chuck and a steady-rest are required. One end of the shaft is held in the chuck, and on the other end a cast-iron cap containing a center is held by set screws, as per sketch. By adjusting the set screws in the cap, and by the chuck at the other end, the shaft is trued up so that there is stock to turn all parts of it. A place is then turned close to the cap for the steady-rest, and the rest is placed and adjusted to it. The cap is then removed, and the end faced off and centered. The tail-stock center is then brought to position, the steady-rest removed and the shaft turned up to the chuck. The steady-rest is now adjusted to the end near the chuck, and then placed at the tail-stock end. The shaft is then reversed, and the faced end put in the chuck or held against the center with a clamp and bolts while the other end is faced and centered. Of course, the turning so far should only be the roughing cut, as the finishing is done on the shaft centers.

This method, like that of Mr. Swift, does not require any temporary centers in the shaft, and is probably more rapid and as satisfactory, because only one truing-up is required, and the shaft is held very solid while the ends are faced and centered.

Mr. Swift's remarks about the use of four screws in place of three for centering are true; but it will be noted on the sketch there are three set screws in the cap against the end of the shaft, and this is a case where three are better than four.



CAP FOR CENTERING SHAFTING.

The October 22d issue of the "American Machinist" contains some shop notes by Mr. Freeland, in which he refers to some accurate wood-planing done on a cylinder planer. By comparing the work done on it with that done on a Daniels planer, he makes it appear that the cylinder planer described is a substitute for the Daniels and much superior for producing true smooth surfaces. Where a true surface on one side of a comparatively short piece is all that is wanted, it will, no doubt, answer the purpose; but for pattern-shop work it is not of much value, because in the majority of cases the pattern-maker not only wants true surfaces, but he wants the two surfaces of a piece parallel. The cylinder planer will produce parallel surfaces only when the piece is parallel before planing; and a little reflection will show that if the stuff is in wind, or sawed thicker at one side or one end, it will not be parallel when it is turned over to plane the other side.

To produce true surfaces on a cylinder planer, the knives must be ground absolutely straight, and the front and rear tables must be perfectly parallel to each other. The truth of the tables is difficult to maintain, because one of them must be adjustable to regulate the depth of cut. When the tables get worn some, the machine will not do true work, and it is a

fine machine-shop job to plane them correctly.

The Daniels planer does not, of course, produce a true plane, because the spindle stands at a slight inclination to the table, so the cutters will not make a second cut at the rear; but this is not sufficient to be objectionable in practice. The cutters can be ground and set very easily by any pattern-maker, and it produces the parallel surfaces so frequently required in pattern work. The cylinder planer would be of some value in a pattern shop; but if only one planer can be had, it should be a Daniels, and, in fact, no modern pattern shop is properly equipped without one.

BELL CRANK.

Salem, O.

▲ ▲ ▲

Lead Lapping a Steel-Lined Cylinder.

Editor American Machinist:

We hear much about grinding machines nowadays, inside and outside grinders, surface grinders and grinders of all sorts; and as the producers and users of machinery become more skillful and better educated, the demand for and ability to construct more accurate and efficient mechanical appliances lead to an increasing use of abrasive processes.

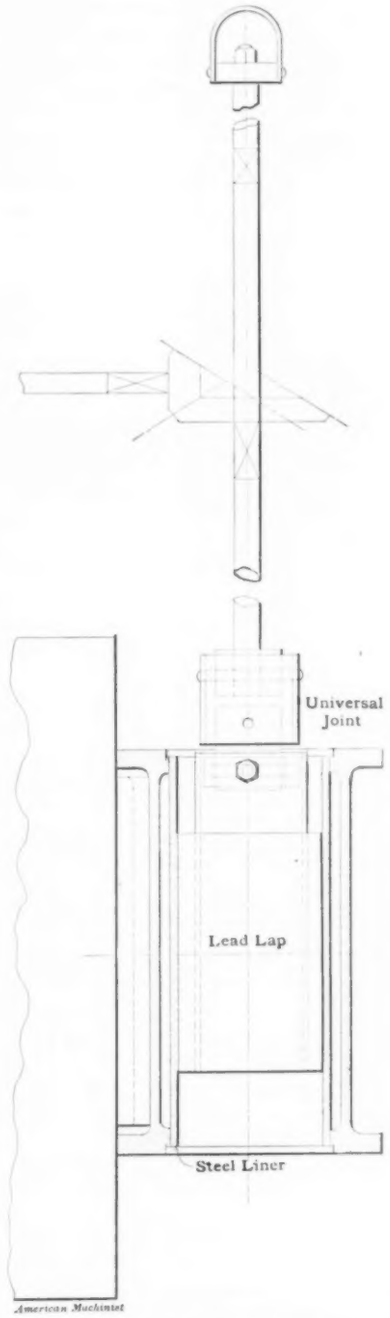
The grinding machine, itself, in its many forms, comprises a distinct class of highly developed machinery, the history of which would, no doubt, be very instructive and interesting.

The accompanying sketch is of a "grinding machine" used by the writer some years ago in producing smooth and accurate cylinders for compressing gas. The principle used, the lead lap, probably familiar to most of the readers of the "American Machinist," is doubtless one of, if not the chief, progenitors of the grinding machine.

An old Dallett portable drill was stripped of everything except the base, frame and gearing. A piece of shafting of the same diameter as the drill spindle, and of proper length, was key-seated its entire length; one end being attached by a universal joint to a piece of pipe, around which was cast the lead for the lap. This joint was made in the cheapest manner possible, of pieces of pipe, a piece of round iron and rough iron pins. To the other end of the shaft a loop was attached by a bolt upon which it turned easily. The lap was turned so it would slip easily through the cylinder as it left the boring mill, and was provided with four large grooves extending about two-thirds the way down from the top, to conduct emery and oil.

We now bolted the cylinder to one side of a large T-slotted cast-iron block, the Dallett drill on the top; put the shaft in, in place of the spindle, centering it roughly with the cylinder by the eye. Attaching a light block and tackle to the loop at the top of the shaft and to the ceiling of the shop, connecting up the usual portable drill drive, and providing ourselves with a can of oil and box of loose emery, we were ready to begin operations with our "internal grinding machine."

The speed and accuracy with which work was accomplished by this contrivance would probably be surprising to some.



LEAD LAPPING A STEEL-LINED CYLINDER.

From three to four hours sufficed to make a 7 x 18-inch cylinder, lined with forged steel, perfectly smooth and of uniform diameter within $\frac{1}{1000}$ inch. The lap would grind out about four cylinders without renewing, when the lead would be recast on the pipe and turned to size again. Of course, there were a few thousandths variation in the sizes of the cylinders, which is obviated in improved machines for this kind of work; but that aside, they will probably do no more or better work than the old lead lap.

W. Y. MIGGETT.

Ann Arbor, Mich.

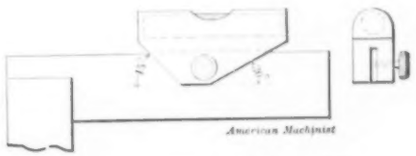
▲ ▲ ▲

A Machinist's Spirit Level.

Editor American Machinist:

In your issue of November 12th I note an article by "Quirk," referring to the abused spirit level. I agree with him that there are places where the level can be used to advantage, even in modern tool-making.

I append a sketch of a "home-made" level which, I am sure from experience, combines many advantages over the ordinary box level or combination level. Its construction is most simple: A block of ½ x 1 inch steel: $\frac{5}{16}$ inch hole reamed nearly through the length $\frac{1}{32}$ inch from the edge, for the insertion of the glass. Mill smooth all over and cut the lower



A MACHINIST'S SPIRIT LEVEL.

edges to 60 degrees and 45 degrees; also mill a slot $\frac{5}{32}$ inch wide, true with the hole for the insertion of straight-edge; scale of any length; steel triangles, etc, clamping the level as shown by the small knurled screw, pressing together with thumb and finger at the same time. I have found this level very convenient to clamp to the blade of the try-square. It is not essential that the blade should fit the slot in level, the screw setting it straight against one side. The center of the slot should be milled deeper, allowing points of contact at each end only.

MAC.

▲ ▲ ▲

Flow of Water in Pipes.

Editor American Machinist:

In the issue of the "American Machinist" for November 12th, Mr. E. Sherman Gould, in making a criticism on one of your answers to correspondents, gives the law for the discharging capacities of long pipes (i. e., pipes of not less than one thousand diameters in length).

I have no doubt that his law is correct, but I would like to know why the pipe must be one thousand diameters in length. Why does not the law hold for any length, eliminating the effect of eddy currents at the inlet, if there are any. Is not each section of a pipe carrying an incompressible fluid subject to exactly the same law? Is not the loss in head just the same for the last foot as it was for the first?

The velocity is the same, and therefore the resistance of the pipe is the same.

It is evident that since the loss in head is due to the resistance of the internal surface of the pipe, the smoother the pipe is the less the loss in head. It is easy to conceive of conditions when the formula would, if applied, lead to an absurdity. For instance, a pipe one-eighth of an inch in diameter, with a surface of feather edges one-sixteenth thick, would not be at all comparable with one twelve inches in diameter with the same surface. Of course, this is carried out to extremes; but, to quote from our friend, Professor Sweet, "the way to see the truth or absurdity of a thing is to carry it to extremes."

Formulæ are all right, but they are not law, and must be used only to assist one in making a guess, and not as law. Very few questions in engineering can be decided by laws. The best engineers have fewest laws.

When a person contemplates two formulæ in which a "constant" enters as a direct factor, and in one it is fifty per cent. more than in the other, each being determined by whether the pipe is smooth or rough, it looks very much like guesswork. One would be obliged to guess at whether the pipe be smooth or rough, and then apply the formula. What would be smooth to one person would be rough to another.

W. COOPER.

Boston.

[The resistance due to the entrance to the pipe, and that due to imparting the velocity to the water,, are independent of the length of the pipe, and, as a part of the total resistance, become of less importance as the pipe increases in length. While Mr. Gould does not explain the matter at length, he obviously considers that when the length of the pipe exceeds one thousand diameters, the entry and velocity heads become so small factors as to be negligible.

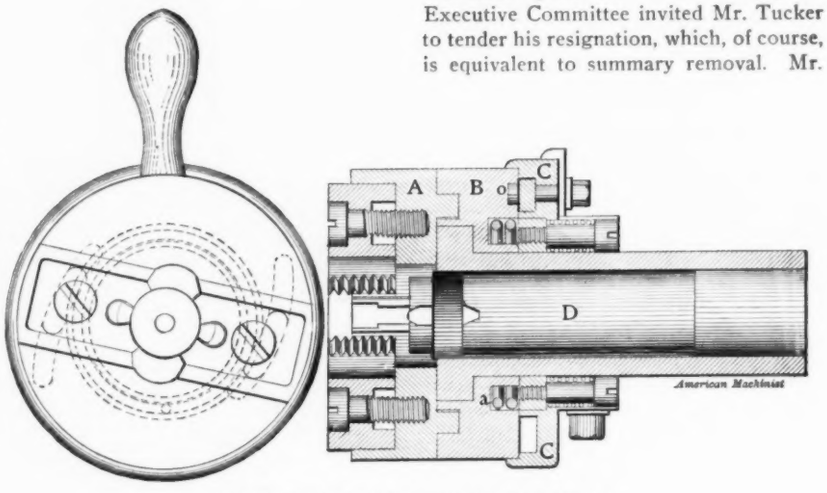
We cannot see that the criticism based on a pipe with internal feather edges is pertinent, as the formulæ are intended for such pipe as is in practical use. The degree of smoothness of the surface is one of those factors which cannot be expressed in absolute figures, and which involve the personal judgment which is inseparable from all engineering work; and while extreme and improbable cases can easily be found to which these, like other practical formulæ, do not apply, it is nevertheless true that within the range of practice, good judgment will enable them to be used with satisfactory results.—Ed.]

▲ ▲ ▲

A New Screw-Cutting Die Head.

We illustrate a new automatic opening screw-cutting die head for use upon turret head and other screw machines. It is provided with a central stop to be adjusted to the length of the thread to be cut, and when the work strikes the stop the dies fly open and the head may be withdrawn. A graduated adjustment is also provided for setting the dies accurately to the required size, this adjustment being entirely independent of the opening movement. The front of the head, which is rigidly connected with the shank, is provided with two cross-slides *A*, which carry the dies. These dies are, of course, interchangeable for those of other sizes or threads, or are renewable when worn out. The cross-slides are provided at the back with lugs projecting into eccentric slots in the collar *B*, and a partial revolution of *B* in one direction closes the dies, while a movement in the other

AUTOMATIC DIE HEAD.



AUTOMATIC SCREW-CUTTING DIE HEAD.

direction throws them open. The end of the spring *a* is attached to *B* with a tension sufficient to open the die at all times. The back plate *C* has a slight movement endwise, but does not turn. Three screws, not shown, in the hub of the back plate *C*, pass through the the shank of the tool without touching it, and hold the adjustable gage pin *D*. Two of the screws are fixed, and the gage pin is adjusted at any time by means of the third screw. When the work strikes the gage pin, the back plate *C* is moved back enough to release the end of the pin *o* from the movable piece *B*, when it flies around and the dies open. This pin *o* passes through a circular slot in the back plate *C*, long enough to allow of all necessary adjustment for the diameter of the screw, a pointer on the plate which covers the slot indicating the movement by graduations on the circumference of *C*. The graduations usually indicate hundredths of an inch, but may be sixty-fourths or otherwise as preferred. The die is closed by the handle shown, and the dropping of the pin *o* into the hole in *B* locks the die. The die may also be closed automatically by means of a pin screwed into *B*, opposite the handle, and attaching a taper piece to the tailstock or the bed of the machine, to engage it when the tool is drawn back. If the thread to be cut is too long to permit the use of the gage pin *D*, the die may be opened by hand by giving the back plate the slight movement required. It will be seen that every part of the head is effectively protected from chips or dirt.

The die head is made by the Geometric Drill Company, New Haven, Conn., and is furnished in four sizes, to cut threads from ⅜ inch to 1 inch.

▲ ▲ ▲

In 1876, Mr. Payson Tucker became connected with the Maine Central Railroad, and his work there has earned for him a very high reputation as a railroad manager. A meeting of the directors of the road was held at Portland, Me., on November 30th, and at this meeting the Executive Committee invited Mr. Tucker to tender his resignation, which, of course, is equivalent to summary removal. Mr. Tucker sent to the Executive Committee the following letter:

"Gentlemen—I have been officially informed that my services as Vice-President and General Manager of the Maine Central Railroad will be no longer required. I am deeply touched. This act of kindness, so nobly conceived and delicately consummated, teaches me that all is not base and sordid in this world, and that the human heart, when connected with the Boston & Maine Railroad, is capable of high and lofty impulses. Wishing you a pleasant journey to Boston this afternoon, I am, as ever, "PAYSON TUCKER."

Worcester R. Warner, President American Society of Mechanical Engineers.

To be elected President of the American Society of Mechanical Engineers must be esteemed no small honor; but in electing Worcester R. Warner, of Cleveland, to that office the society has at the same time honored itself. Certain it is, moreover, that no choice could have commanded the heartier or more nearly unanimous approval of the members themselves, as well as of the great body of men engaged in machine construction who, though not members, are yet concerned for the welfare of this representative organization.

Mr. Warner may be regarded as a typical product of New England and of America. Born and reared on a farm which has been the homestead of the family for four generations, and is located among the hills of Western Massachusetts in the town of Cummington (birthplace, likewise, of the poet Bryant), Mr. Warner early showed an inclination toward mechanical and scientific pursuits. All his spare hours were devoted to experiment and effort along these lines, and no little ingenuity was manifested in his methods of investigation.

At the age of nineteen he left home for Boston, and entered the office of an engineering company to learn drafting and designing. At the end of a year he went into the company's shops at Exeter, N. H., where he worked at the machinist's trade in order to gain a practical knowledge of machine construction and operation.

WORCESTER R. WARNER,
President American Society Mechanical Engineers.

In 1870, together with Mr. Ambrose Swasey, his present partner, he left for Hartford, and entered the employ of Pratt & Whitney. During Mr. Warner's association with this well-known firm, he had charge of one of their largest departments of machine-tool construction, and also managed their extensive exhibit at the Centennial Exposition in Philadelphia.

All this time, in addition to his engrossing labors, he was prosecuting his private studies, both in engineering and astronomy. His deep interest in this latter science, which was to bear notable fruit later on, had been awakened in him as a schoolboy, and then intensified by reading that fascinating work, Mitchell's "Planetary and Stellar Worlds," a copy of which his parents had presented to him, with other books, when he first left home. In pursuit of this study, it was natural that he should investigate the various instruments peculiar to observatory outfits, and scarcely strange that, from the standpoint of a trained mechanic, he should have found much to criticise and improve in their construction.

When, therefore, in the spring of 1881, Mr. Warner and Mr. Swasey left Hartford for Cleveland, to enter upon the manufacture of machine tools and special machinery, the possession of their own plant gave opportunity for experimentation also in instrument making, and it was not long before a 9½-inch equatorial telescope was completed. In its construction many of the traditions of the instrument maker were disregarded, and the mechanical processes involved were solved by original methods. The improvements attained were generally recognized and sought after by astronomers, so that from this small beginning has come to pass Warner & Swasey's recognized leadership in the construction of astronomical instruments.

In their shops at Cleveland were designed and built the great 36-inch Lick telescope, and the still greater 40-inch equatorial for the Yerkes Observatory. The telescope and dome of the National Observatory at Washington have been recently reconstructed by them, while smaller instruments of their make are to be found in the modern observatories, not only of this, but of foreign countries, where their merits have been generously recognized.

Adjoining each other in Euclid avenue, stand the tasteful homes of Mr. Warner and Mr. Swasey. A driveway between leads directly to the door of their private observatory, and here is installed one of their 10½-inch telescopes of the most modern construction, which furnishes opportunity for Mr. Warner to continue the studies so attractive to him from his boyhood, and so influential in determining his business career.

Mr. Warner is often called upon to lecture on Astronomy, and his practical as well as theoretical knowledge of the subject makes his lectures especially interesting and instructive.

His genial cordiality has won him a large circle of friends, both at home and abroad, and he holds many positions of honor and trust in Cleveland, being one of the trustees of the Case School of Applied Sciences, past president of the Civil Engineers' Club, and director in some of the largest banking institutions.

Mr. Warner's extensive travel has familiarized him equally with the more important engineering works and famous astronomical observatories, both of our own and foreign countries.

He has prospered in business for no other reason than because he deserved to—because he possesses a happy combination of business ability and mechanical and engineering skill — because, both in public and private life, he is the type of man in whose success all may rejoice without reservation.

While we are aware that Mr. Warner would not have us overlook the important part Mr. Swasey has taken in the notable achievements of their firm, yet it must be remembered that in this sketch we are dealing only with the newly-elected President of the American Society of Mechanical Engineers.

▲ ▲ ▲

On the following pages is a report of the proceedings of the A. S. M. E. at its recent meeting which is as full and complete as we can arrange for this issue. Some of the papers and the discussions on them will be more fully presented later.

The New York Meeting of the American Society of Mechanical Engineers.

The seventeenth annual meeting of the American Society of Mechanical Engineers was held in this city last week in the society house, the first session being called to order at 9 o'clock Tuesday evening, when the annual address of retiring President Fritz was read. The title of the address was "The Progress in the Manufacture of Iron and Steel, and the Relations of the Engineer to It."

The address was largely a historical sketch of the progress of this branch of metallurgical work during the past sixty years, at the beginning of which period the output of a blast furnace ranged from fifteen to thirty tons per week, while at present, outputs of four thousand tons have been reached. The address was full of reminiscences of the distinguished author's connection with the industry, and was of profound interest to younger men, as showing something of the trials and difficulties of the past, and could not but force home to all such the feeling that "there were giants in those days." Contrary to custom, the address was thrown open to discussion, which was participated in by Messrs. Andrew Carnegie, A. H. Jacques, Robt. W. Hunt, Robt. Forsyth, S. F. Wellman and Allan Stirling. This discussion consisted largely of expressions of the high esteem in which Mr. Fritz is held by all, and could not have been otherwise than profoundly gratifying to him.

Wednesday Morning Session.

Wednesday morning was the annual business session, at which the reports of the Council, Finance and Library Committees were presented, together with that of the tellers of election and the various special committees.

The report of the Council showed a total membership of 1,762, and the finances to be in a very satisfactory condition. The tellers of election reported the following as the newly elected officers: President, Mr. W. R. Warner; Vice-Presidents—E. S. Cramp, S. F. Wellman, W. F. Durfee; Managers—H. S. Haines, G. C. Henning, E. P. Robinson; Treasurer, W. H. Wiley. The report of the Council also contained a copy of a memorial to the Congressional Committee on Naval Affairs, indorsing the Wilson-Squire bills for the reconstruction of the rules and regulations which govern the Corps of Engineers of the United States Navy, which bills are based on the lines with which our readers are familiar through the long advocacy of them in these columns.

Mr. C. E. Emery, Chairman of the Committee on Boiler Tests, reported progress. This committee has endeavored to formulate a scheme by which the efficiency of boilers should be incorporated in tests in addition to the rate of evaporation. The idea is a very attracive and apparently a simple and feasible one, but examination of the question had developed unexpected and formidable difficulties. Apparatus for determining the true calorific value of coal is not sufficiently well developed to enable identical results to be obtained by different observers, and, in addition to this, the real thing desired in a boiler test is the evaporation per pound of coal. More serious yet, the efficiency test, by ignoring the refuse and making the results depend entirely on the combustible, leads to anomalous results by which, with some coals, low efficiency and high evaporation go together. A report was promised when the committee could agree, but no great promise of agreement was held out.

Mr. Henning, Chairman of the Committee on Tests of Materials, reported progress and stated that the report on cast iron might be expected at the next meeting.

A communication from A. L. Colby, President of the Association of Steel Manufacturers, was announced by the secretary, to the effect that that association had adopted the decimal inch sheet-metal gage recommended by this society.

Following the business session professional papers were taken up, the first one being:

Historical and Technical Sketch of the Origin of the Bessemer Process.

BY SIR HENRY BESSEMER.

In view of the vast development and far-reaching importance of the Bessemer process, this paper, which is, we believe, the first by its eminent author to put before the world in full its early history, will be found of great interest. It will also show to any who may need showing, that the invention of this process involved far more than merely blowing air through molten iron. The whole system of apparatus by which the metal is handled and manipulated, beginning with the rotating converter, had to be devised, and Sir Henry properly felicitates himself upon the fact that in spite of the vast development of the system, with the ceaseless activity of those engaged in its working, "my invention still exists in active operation in every steel making country in the world, intact in all its main features and in almost every detail as it left my hands forty years ago."

Several of the forms of apparatus used in the early experiments are illustrated, and it is by the study of these that the magnitude of the problem involved in the development of the process beyond the initial idea can be in a small measure realized.

Sir Henry's claims to priority for some of the details of the process have been assailed in various quarters, and he pays his respects to the claims of Kelly and Mushet, and while these are secondary features of the paper, we cannot but think that the putting of his claims on record regarding these points, was largely the real object of the paper. These claims were not allowed to go unchallenged. Mr. W. F. Durfee, as the sole surviving participant in the work of Wm. Kelly, presented a written discussion and statement of the facts regarding Kelly's claims. He stated that the American representatives of the Kelly interests had been repeatedly assailed in England as pirates and robbers, and that until now he had allowed these vituperative expressions to go unchallenged, but that the present paper from Mr. Bessemer himself, ignoring Kelly's claims, could not be allowed to pass, and he addressed himself to the task of publishing the facts. He also stated the facts regarding Mr. Mushet's invention of the use of spiegeleisen, claiming that the claims of Sir Henry were entirely unfounded. Written discussions of these points were also presented by Messrs. Allan Stirling, Robt. W. Hunt and Wm. Kent. The temper of this whole discussion was admirable. The highest respect for Mr. Bessemer was expressed by all, and the merit of his work was fully recognized. His lack of generosity and justice in recognizing the legitimate claims of Kelly and Mushet were characterized by Mr. Hunt as the "spots on the sun." which dimmed the lustre of Sir Henry's fame, and the spirit in which his statements were refuted was distinctively that of sorrow rather than anger. That Kelly preceded Bessemer in the conception of the idea of forcing air through molten iron seems to be established, though that Kelly ever brought his process to the point of success was not claimed. It was also pointed out that some features of Kelly's converter, which Sir Henry ridicules in his paper, are in fact the very features that have been adopted in some of the most recent and advanced plants. The shallowness of his claims to have anticipated Mushet in the use of speigeleisen were also pointed out.

Ancient Pompeiian Boilers.

BY W. T. BONNER, NEW YORK.

This paper gives several highly interesting views, from photographs as well as sectional drawings, of relics found in the ruins of Pompeii. The aim is to show that "the water tube principle, the crowning feature of the most successful boilers to-day, was fully understood and appreciated by the Greeks and Romans two thousand years ago."

The boilers shown were intended for heating water for domestic use, and are not far removed in design from the upright internally fired boiler of to-day except that they have not the system of flues now used. In one case the smoke escaped through the fire opening, and in another a few short horizontal flues were provided leading from the firebox through the outer shell.

The water tubes are in reality water grates, and while they may in a sense be said to foreshadow the present water tube boiler, it is certainly in a very elementary form and one which scarcely justifies the claim that "the water tube principle was fully understood and appreciated two thousand years ago."

In the discussion Mr. Durfee stated that there was on view to-day in the museum at Naples, a boiler of the Pompeiians having its firebox and tubes arranged precisely like the standard vertical boiler of to-day.

The Moment of Resistance.

BY C. V. KERR, FAYETTEVILLE, ARK.

This paper points out the inconsistency of the use of the term moment of inertia in connection with the formulæ for the strength of beams, for which the author proposes to introduce a more appropriate term the "moment of resistance." The paper proceeds to give a set of formulas for the more usual shapes of beams, in which the usual and somewhat intangible conception of the moment of inertia does not appear, but instead the concrete moment of resistance which the author proposes. Following this comes—what to many will be the most valuable part of the paper—a graphical method of finding the bending strength of such shapes as do not lend themselves to exact analytical treatment.

Method of Determining the Work Done Daily by a Refrigerating Plant and Its Cost.

BY FRANCIS H. BOYER, EAST CAMBRIDGE, MASS.

The object of this paper is chiefly to show a method of reducing the work done under varying conditions of speed and pressure to a common standard set of conditions such as are named in the usual guarantee given with a plant, but which can seldom be exactly maintained in actual work.

In discussing the paper Mr. Geo. Richmond spoke of the value of reliable data upon this subject and of the present paper as a contribution to it. He spoke of the impropriety of basing such computations upon gage pressures instead of absolute pressures, and also of using the rated capacity of the apparatus as of any significance in the connection, also of the undue significance assigned to the return pressure.

The author in closing said that the De La Vergne Company make their guarantees upon the return pressure.

The Promise and Potency of High-Pressure Steam.

BY R. H. THURSTON, ITHACA, N. Y.

This was an elaborate paper reviewing the progressive raising of steam pressures and increase of economy in steam engines during the past century, and endeavored to forecast the probable results of still further increase of pressure. An engraving was presented of an experimental engine built in the Cornell shops for use with steam at 500 pounds pressure. In experiments with this engine, more difficulty has been found with the boiler than with the engine. One of the conclusions to which the author has arrived, is that the ultimate limiting condition to pressures to be used will be financial and not mechanical—that is, a point will finally be reached when the gains due to increase of pressure will not be sufficient to compensate for the additional cost involved.

The discussion consisted of some questions and replies.

Wednesday Afternoon Session.

Wednesday afternoon was devoted to a memorial session in memory of Mr. J. F. Holloway. It was opened with a biographical sketch of Mr. Holloway prepared by Professor Hutton, which also explained the great assistance and unselfish labors of Mr. Holloway in the conduct of the society. This was followed by fitting remarks by about fifteen of the members, testifying in the warmest terms to the respect and affection in which Mr. Holloway was held.

Mr. Hosea Webster, of the Worthington Pump Works, related a story which has become traditional at those works as an illustration of the charming personalities of both Mr. Holloway and Mr. H. R. Worthington. An action at law was in progress in which Mr. Holloway was defendant for an infringement on the Worthington patents. In the course of the suit the two were introduced, and were soon on terms of cordial intimacy, when Mr. Holloway suddenly remarked: "Mr. Worthington, if I had known you I would not have built that pump"; to which Mr. Worthington replied: "Mr. Holloway, if I had known you I would not have brought this suit," and action was suspended then and there and an amicable adjustment made.

Another incident, told by a former apprentice in the Cuyahoga Works, related how in doing a job on a slotter which, like most of the tools of the shop, had seen its best days, he was making slow progress, and probably showed his perplexity in his face. Mr. Holloway happened around, and sizing up the situation at once, remarked in his cheery way: "My boy, the old machine will do better after it gets acquainted with you." Needless to say, the tension of the atmosphere at once relaxed, and the acquaintance of machine and operator rapidly ripened.

Both incidents were given as being characteristic, and as revealing the character and personality of a man who endeared himself to all with whom he came in contact.

Wednesday Evening.

Wednesday evening was devoted to the usual officers' reception, and was held at Sherry's. This reception has come to be a prominent feature of these conventions, especially to those acquainted with the terpsichorean art, which apparently includes most of the profession. Needless to say, this occasion was much enjoyed, and it was certainly very largely attended.

Thursday Morning Session.

Experimental Investigation of the Cutting of Bevel Gears With Rotary Cutters.

BY FORREST R. JONES AND ARTHUR L. GODDARD, MADISON, WIS.

Where bevel gears are made in the shop in which they are to be used and not manufactured regularly, they are usually cut upon the universal milling machine, and the process is largely one of "cut and try," especially that part of it by which the last cuts are made, first on one side of the tooth and then the other, to make the curve of that part of the tooth above the pitch line as nearly right as practicable. This paper is, so far as we know, the first record of an attempt to systematize this part of the operation, and to formulate a rule for the angular displacements to produce the best compromise in each given case. The authors of the paper conducted their investigations experimentally, and constructed an apparatus which enabled them to set templates representing the shape of the gear teeth at the inner and outer ends to a position corresponding to the gear blank in a milling machine, and then to give to these templates and to a third template representing the gear cutter, the required motions corresponding to those of the milling machine, and from the observations thus made they constructed a diagram from which is deduced the settings for different gears. We shall publish the paper in full in an early issue.

Calibration of a Worthington Water Meter.

BY JOHN A. LAIRD, ST. LOUIS, MO.

In this paper the author describes and illustrates the method and the apparatus adopted for calibrating a water meter of the Worthington type made entirely of brass, for hot water, and bought for testing purposes. This meter was used to measure the feed water during the duty test on the Allis engines at the Chain of Rocks Pumping Station, St. Louis. The method pursued was to place the meter upon a platform upon which were two platform scales, each having upon it a tank designated as "No. 1" and "No. 2," respectively. Water was first passed through the meter, and its temperature was noted by a thermometer, the bulb of which was inserted in the pipe near the meter. From the meter the water passed through a pipe and to a branch, at the intersection of which branch was a three-way cock, by which water could be turned into either of the tanks mentioned. The water was filled into each tank alternately, and was weighed, and from the record of this weighing the correction for the meter

was deduced. The percentage of error for the meter as given in a table forming part of the paper was on some days as low as .1 of one per cent., the maximum error being 2.5 per cent. The author expresses it as his belief that by careful calibration, results can be obtained with the Worthington meter which would not be in error more than ½ of one per cent.

Contraction and Deformation of Iron Castings in Cooling, from the Fluid to the Solid State.

BY FRANCIS SCHUMANN, PHILADELPHIA, PA.

This is a very elaborate paper in which the author sets out to establish the relations between the cross-section and form of castings and their contraction and deformation in cooling. He first states the general laws which he conceives to be those which govern the action of castings in the mold, and says that contraction takes place just when incandescence disappears, or when the color changes from red to black, and continues until the temperature is normal to that of the surrounding mediums.

A prism cast in a sand mold will maintain its alignment after cooling in the mold, provided all parts around its center of gravity of cross-section cool at the same rate.

Deformation is due to unequal contraction of the elements of the cross-section surrounding the section of gravity of the section.

Unequal contraction is due to the unequal cooling, causing or tending to cause initial stresses in the elements of the prism, resulting in deformation or rupture.

Slow cooling develops larger crystals, less density and increased ductility. The fracture is darker or more gray in color, the surface uneven and rugged, and the carbon is in a more free state. The contraction is lessened and the casting has greater resistance to shock, although its resistance to a quiescent cross-breaking force may be less.

As strength and hardness result from slight increase in the proportion of combined carbon to that in a free state, it follows that the strong irons have a greater rate of contraction than those in which a lesser amount is present.

Increasing the silicon, say up to 10 per cent., causes the iron to become brittle, hard and weak, and increases contraction.

Sulphur tends to change the carbon into the combined state, and hence increases the rate of contraction.

Phosphorus tends to harden the iron, and lessens the rate of contraction, and diminishes the strength of the iron.

Manganese up to 1 per cent. has no appreciable effect; but when it reaches 1.5 per cent. in an iron which is low in silicon, it tends to hardness and increases contraction.

The cross-sectional area of test pieces for determining the rate of contraction for a given mixture of iron should increase with the increase of combined carbon contained in the mixture, when intended for large castings.

The paper includes cross-sections of a number of castings of various forms with the computed and actual deformation of such castings, and shows that the computation closely agrees with the actual results; the author claiming that from the rules and formulas thus laid down, it is possible to say what proportion or form patterns should take so as to counteract the probable effects of shrinkage strains.

Among the author's conclusions are: That sudden changes in form cause severe initial stresses, if not fracture, and should be avoided. Imperfectly proportioned flanges, ribs or gussets added to the main body of castings, either for the purpose of strengthening or connections, may be sources of weakness.

In discussing this paper, Mr. Gobeille, of Cleveland, referred to steel castings and to the great variation in the practice of different makers of such castings regarding shrinkage; the actual range of variation in this respect between different makers being 5-16 inch to the foot, as shown by his experience in making patterns for such castings. Some makers required patterns for steel castings to have what may be called negative shrinkage, i. e., to be smaller than the casting.

Mr. Gus. C. Henning presented some discussion by Mr. Keep, which, as was also the case with his own remarks, tended to show that the results obtained by Mr. Schumann agreed practically with those obtained in the experiments and tests which have been carried on by the Committee on Testing, to whose work we have previously referred, and which are based on Keep's system. Mr. Henning thought, however, that the author of the paper had been a little too much inclined to assume that cast iron is a uniform material, always alike, whereas, in fact, it is a very variable material, and no one can say beforehand just what it is going to do unless he knows from previous experience with the same iron.

Mr. John Brashear spoke of the difficulties encountered in getting suitable castings of glass out of which to make telescope lenses, and said that the strains resulting from unequal cooling revealed themselves very plainly in glass castings, and their effects could be readily perceived by aid of the polariscope. It had been ascertained that the critical period in a glass casting was at the point of incandescence, and Mr. Brashear thought that if a furnace could be arranged in which castings or test pieces of iron could be brought to that point and then cooled very slowly, some valuable results ought to come from it.

Mr. Henning thereupon stated that the committee had been endeavoring to arrange for just this thing and had the promise of suitable pyrometers, with which it was expected that temperatures could be accurately determined.

President Fritz here told of a man they once had who had grown to be an expert in making and arranging sweeps for molds. Once, when a large cylinder came out ½ inch too small, he was asked how that was and said there must have been an unusual amount of shrinkage. Afterwards the cylinder was found to be ½ inch too long, and upon being confronted with this fact the sweep expert declared that the iron that had shrunk "had to go somewhere." This raised a laugh, but the author of the paper said there was, in his opinion, something in it nevertheless, and that in dealing with these matters of shrinkage, not simply one measurement but volumnal shrinkage should be dealt with.

Mr. Keep's system of casting test pieces in a yoke was criticised and defended, and one member spoke of a man who, to show what could be done, made a number of castings from a pattern resembling a flywheel with arms, but with the arms unusually light in proportion to the rim. Cast in the ordinary way, these arms always broke from shrinkage; but when heavy masses of metal were cast between the arms, in the same mold but not connected to the wheel in any way, the prevention of rapid cooling effected in this way entirely prevented such breakage.

A 200-Foot Gantry Crane.

BY JOHN W. SEAVER, CLEVELAND, O.

In this paper the author describes and fully illustrates a crane which may be best described perhaps by saying that it is a truss bridge of 200 feet span, resting at each end upon an *A* frame, the legs of which frames rest upon four-wheeled trucks, these trucks running upon rails or tracks of 3 feet 6 inches gage.

The trusses are of the Pratt type, and are inclined to each other at the top at an angle of 30 degrees, so that a cross-section of the crane forms an equilateral triangle. Near the bottom of the triangle thus formed are the rails upon which the trolley runs. Two of these cranes were constructed for the Cambria Iron Works, Johnstown, Pa., to cover a yard 400 by 800 feet. They are placed upon tracks parallel with each other, and so arranged that they can be locked together, and the trolley of either crane run over onto the other, and thus the entire surface of the yard is covered by the two cranes. The hight is sufficient to permit a train of cars to pass underneath, with head room sufficient for men standing on top of the cars, and by electric motors the cranes are moved on the surface tracks and the trolleys are moved upon the bridges and the loads hoisted. The crane is calculated for a live load of 20,000 pounds.

To provide for contraction and expan-

sion, each leg of the *A* frames is connected to its four-wheeled truck by a hard steel ball which is 6 inches in diameter and rests in a socket or a cup which is elongated in a direction at right angles to the center line of the truck, thus allowing the ball to move with the contraction or expansion of the trusses, while at the same time allowing the trucks to be slightly out of alignment, without imposing abnormal strains upon the structure.

A member expressed the opinion that the crane was rather heavy for the loads designed to be handled, and that its efficiency was low; a 100 horse-power motor being required to raise a load of 10 tons 20 feet per minute. It was shown in discussion, however, by Mr. Henning and by the author, that the cranes were probably the best possible adaptation to the conditions, since they covered the entire area without obstruction and cost less to construct than any alternative plan that was available. It was pointed out that it would seldom be required to move an entire crane when loaded, the movement on the tracks being mainly to enable the crane to be placed in position for carrying loads by the trolley at any convenient point in the yard.

The Washing of Bituminous Coal by the Luhrig Process.

BY J. V. SCHAEFER, CHICAGO, ILL.

This paper describes and illustrates what is known as the Luhrig process of washing coal. The process is interesting chiefly to those who have to do with coal-mining operations, but its results are interesting to engineers and others who are consumers of coal. This washing process can be made to remove the major portion of the incombustible constituents of coal, thus reducing its tendency to form clinker and making the coal decidedly better, especially for coking purposes, though it is claimed to be economically advantageous where the coal is to be used for steam making also.

The author states that in a bituminous coal having 18 per cent. of ash, there is probably 10 per cent. that might be left at the mine by a thorough process of washing, and that since in many cases as high as 70 per cent. of the price a consumer pays for coal goes for railroad transportation; 7 per cent., therefore, of the price the consumer pays goes for transporting that which he does not want, and which to him is worse than useless. This 10 per cent. he states can be washed out at the mine at a cost of 2 to 5 cents per ton, and it follows from this that the transportation charges alone will pay for the cost of its removal; and as this washed coal will have 11 per cent. greater calorific power, the consumer can afford to pay for it such a price as will leave a liberal margin of profit on the washing operation.

The author gives an instance of the results achieved at Union, B. C., where by this process the ash is reduced from 35.5 per cent. to 8.5 per cent., the fixed ash in this coal being 7.8 per cent.; showing that the coal is washed to within 1 per cent. of its fixed ash.

Friction Horse-Power in Factories.

BY C. H. BENJAMIN, CLEVELAND, O.

This paper gives the results of investigations made by its author and by Messrs. McAllister and Morley, of the Case School of Applied Science, Cleveland, in sixteen different industrial establishments (comprising rolling and stamping mills, bridge works, general machine works and screw factories), on the proportion of power generated that is used up in friction of line shafting, countershafts and by belts. The method pursued was to take cards from the engine during the day at intervals of about one hour, while the factory was in full operation, and then at other times such as at noon, and in the evening, when the work of the factory had stopped. Averages of the two sets of cards were assumed to show the total horse-power and the friction horse-power of the establishment. The shafting was measured, belts were counted and measured, and full data of the results are given in tabular form. The lowest percentage of horse-power required to drive shafting was in the case of an establishment making steel wood screws, which at the time the test was made was employed to only one-fourth its full capacity, and yet, notwithstanding this, the percentage of horse-power required for line shafting was only 14.5; the next percentage above that being 39.2; and from these figures the percentages run up to a maximum of 80.7, which last figure was in the case of an establishment using bridge machinery and employed to nearly its full capacity. It is explained in the paper that the good results obtained from the screw-making factory are due to superior construction and care of the transmission apparatus.

The conclusions of the author are, first, that large pulleys should be used on counters and narrow fast running belts; that nothing but the best oil and plenty of it should be used, and that this should be caught after use, purified for use again, or used for other purposes; that all shafting and counters should be oiled regularly and not too much dependence placed upon automatic oiling; and finally, that line shafts hould be inspected regularly from time to time to see that they are in line and can be turned easily. One case is mentioned where the manager of the works said he wished the test could be made again, as he had since found one of his line-shaft bearings which was over 3 inches out of line.

Chas. H. Manning said the results shown by the paper emphasized the importance of keeping line shafts and their bearings in good order. He said that a distinction should be drawn between the friction of a line shaft when no work was being done and when fully loaded, and that when unloaded the line-shaft friction of a cotton mill should not exceed 15 per cent. When it did exceed this figure the matter should be looked into.

The discussion drifted into the question of the relative merits of the different methods of transmission as compared with electric wires and motors, the net result of this being the already well-established fact that the choice depends upon conditions, and that where power has to be carried considerable distances, and applied at many different points, electric motors are usually best adapted, and, as now made by the well-known concerns, are entirely reliable and trustworthy.

Thursday Evening Session.

Some Special Form of Computers.

BY F. A. HALSEY, NEW YORK CITY.

In this paper the author first describes and then explains a method of using and the advantages in practical use of what our readers know as the Cox computer, and the paper gives instances of the efficiency of the instrument in problems connected with the design and selection of gearing to fulfill any requirements as to horse-power. In presenting the paper, Mr. Halsey had before the audience a large model of the gearing computer, and his practical demonstration of the facility with which problems could be solved with it were received with demonstrations of applause. There was no discussion.

Rustless Coatings for Iron and Steel.

BY M. P. WOOD, NEW YORK CITY.

This is the fourth paper of a series by the same author, treating of this subject, and forming what may be called almost a complete treatise on the subject of oxidation of iron and steel and its prevention.

The author evidently believes that in the case of the larger buildings being constructed in New York and other cities, the means taken to prevent oxidation are very inadequate, and that sooner or later trouble must result from this fact. He states that nothing like a washing-down of the parts with soda-ash or lye water to remove the grease, and then pickling with weak acid to remove the mill scale, and a subsequent washing with lime water to neutralize the acid bath, warming the work before painting it, and taking care to apply the paint only on bright clear days when no sweating can occur, or applying paint in warm paint rooms, is known in such building constructions. He states that a poor paint properly applied to a properly prepared surface will in general give better and more lasting results than a good paint improperly applied to an improperly prepared surface.

Linseed oil, free from pigment, applied to any metallic surface absorbs moisture as freely as a sponge, swells up, loosens its bond on the metal, and rarely if ever

renews its bond on the metal when dried out. A properly prepared paint could be as readily prepared as the oil and would take no longer to dry, and would resist friction and moisture greatly in excess of an oil coating. He condemns the use of the iron oxide paints for metals, and says that samples from the many concerns turning out cheap paints show that none are good, and that all are comparatively useless for the protection of the metal.

In this paper an instance is given of a curious and interesting case of corrosion of a steamship, the "Glenarm," which was built in Belfast in 1890, and while carrying a cargo of "burnt ore" struck a rock and was beached where the sea stood a little over her after-deck at low water, and close up to her bridge deck at high water. After being submerged six days she was pumped out and raised. It was found upon examination that the metal of her engines and boilers wherever it could be reached by the sea water, which also was in contact with the burnt ore cargo, was pitted and softened, so that about $\frac{3}{32}$ inch depth of the metal had to be removed by planing and turning; even the cylinders requiring to be bored out to remove this softened iron from them.

It is explained that the burnt ore is the residue of the manufacture of vitrol from sulphur pyrites, and generally contains about 4 per cent. of sulphate of copper, together with a little sulphate of iron due to the sulphur not having been burned out of the ore and becoming oxidized into sulphates. The sulphate of copper would be more or less completely dissolved in sea water; and as the latter contains a considerable amount of common salt, this would react on the sulphate of copper, forming sulphate of sodium and chloride of copper. The sulphate of copper and chloride of copper are both soluble in water, and a solution of either or both dissolves both wrought and cast iron. Every hundred tons of this cargo is stated to have contained as much sulphate of copper as would, if available, dissolve nearly 32 cwt. of metallic iron.

It was pointed out in discussion that this burnt ore was undoubtedly intended to be used for making iron oxide paints, and that large quantities of such paint were made abroad. Considerable quantities of it were imported, but mostly of the better grades. The speaker thought that what he called the natural oxide paints made here were far less dangerous.

The Secretary read a written discussion contributed by Francis H. Boyer, in which he described a chain bridge at Newburyport, Mass., which had been built 104 years ago; had been painted with black paint, but not within the last 30 years. It was exposed to salt sea air; the salt water flowing back and forth under it with the tide. The links of the chains were of square iron, welded by a blacksmith, and the hammer marks were still plainly visible upon them, the iron having apparently suffered no oxidation. Mr. Boyer thought the responsibility in regard to oxidation should be upon the iron and steel makers, who should make their product non-oxidizable.

The discussion finally took the form of comparisons between the strength of different kinds of joints of wires used in bridge cable construction, and Mr. Henning spoke of his experience in these matters in the construction of the East River Bridge, and in the strengthening and enlargement of the Cincinnati Bridge, now going on. They had found by experience that brazing was the best form of union. Dealing with hard drawn steel wire of about 190,000 pounds tensile strength, 70 carbon, electric welding had by its annealing action reduced the strength of such wire from 5,600 to 3,500 pounds, while with brazing it had been found much stronger than this; how much stronger the speaker did not state. The Cincinnati Bridge was built in 1865, and it had been found to be now in good condition so far as oxidation is concerned. Mr. Henning believed a good protection was paraffine applied hot; care being taken that this might not be removed by subsequent handling. The anchor bars of this bridge had been first coated with paraffine hot, and then, after being put in place, hot paraffine was poured around them. The speaker did not think it would be at all practicable to remove the mill scale from structural steel, because the expense of doing so would be prohibitive.

Chas. E. Emery spoke of his experience with one of the earliest iron vessels. He had been called in to inspect the vessel, and with private instruction to "keep her going, if possible, for money was scarce." One of the methods adopted to restore confidence in the vessel was to set the officers, who were little accustomed to hammer and chisel, at the work of cutting holes through the plates. It was found that where the iron had been kept covered is was practically as good as new, after many years' service, and the speaker thought that if iron and steel were kept covered and thoroughly protected from action of water and air, using almost any kind of paint so long as enough of it was applied, no serious oxidation could take place. He said that a coating of linseed oil that had been applied to a metallic surface appeared like tripe under the microscope, and that any pigment put into it simply filled up these interstices and improved the protection.

During the discussion, Mr. Henning stated, in answer to an inquiry, that the screwed couplings used for joining wires in the East River Bridge had shown from 83 per cent. to 92 per cent. of the strength of the wire. The thread is tapered, running out to practically no thread at each end of the coupling; and as the coupling is screwed onto the ends of the wire, the two points pass each other and lock.

A Method of Determining Selling Price.

BY H. M. LANE, CINCINNATI, O.

This is a paper which we happen to know is the result of very considerable study given by the author to the problem of so arranging a cost account system as that it will show at intervals of a month, or if desired one week, how nearly the actual operations of an industrial establishment are conforming to the estimate previously made of what it should do in order to have the balance on the right side of the ledger at the end of the year. The idea is to so arrange things that a manager will not have to wait until the end of the year to find out whether he has made or lost money, but can determine at intervals of a week, as he may choose, whether he is going in the right direction or not, and in what department excessive expenditures are being made, thus giving an opportunity of correcting defects at once instead of allowing them to go on until perhaps too late to be remedied. A sample page of such an account is given which is necessary to fully understand the matter, and which cannot be presented at this time, but it may be given later. The paper was presented by its author.

The balance of the evening was taken up by a report by H. de B. Parsons, representative of the society on a committee appointed to make tests of fireproofing materials. The report was not a final one, but gave an account of what had been done to date. Pictures were thrown upon the screen showing ruins of "fireproof" buildings that had been destroyed by fire, and finally some drawings and photographs of a plant of furnaces erected in the yard of the Continental Iron Works, Brooklyn, for testing beams under compression while at the same time they are subjected to either a rapidly or a slowly rising heat as may be desired. Drawings and photographs of several wrought riveted and cast-iron columns were shown before and after testing, all of them having failed at about red heat and at about one-half their normal safe loads.

Friday Morning Session.

The session of Friday morning opened with a paper on

The Efficiency of the Boiler Grate.

BY W. W. CHRISTIE, PATERSON, N. J.

In this paper data from 108 boiler tests are collected and plotted with a view of determining the rate of combustion per square foot of grate which gives the highest evaporation per pound of coal and combustible. A mean line is drawn which is intended to average the observations and disclose the law of the same. This mean line gives a steadily increasing rate of evaporation as the rate of combustion increases up to 13 pounds of coal per square foot of grate per hour, beyond which it again decreases, the conclusion

being that this rate of 13 pounds is the most economical one.

At the conclusion the author develops some rules for proportioning grates and chimneys.

The discussion was opened by Mr. R. E. Curtis, who thought it an error to attempt to base deductions of this kind on the rate of combustion only, as other factors of as great or greater importance enter the problem which are here ignored.

The discussion was continued by Mr. Wm. Kent, who indulged in what may be fairly called destructive criticism, stating at the outset that he considered the paper "absolutely wrong from beginning to end." He found obvious arithmetical errors in some of the data, and others gave such high rates of evaporation as to be incredible. Finally, the average line of the diagram was incorrect and did not represent a true mean of the observations. Discarding some of the observations as obviously erratic, and then making a correct mean of the remainder, he found that the results were quite the contrary to the conclusions of the paper, and indicated that within the limits of the observations —from about 4 to 41 pounds of coal per square foot of grate per hour, the rate of evaporation per pound of coal was independent of the rate of combustion—a fact which has already been established for higher rates of combustion.

Following this, Mr. Kent referred to his well-known formula and table for chimneys, and explained that it was based upon a large number of data, and not on a single one, as had been sometimes assumed.

Mr. W. Barret Le Van related some of his experience, showing the extremely vague character of boiler and chimney rules, saying that the performance of the same plant doing the same work would vary from day to day with varying atmospheric conditions.

Efficiency of Boiler Heating Surface.

BY R. S. HALE, BOSTON, MASS.

This paper is quite mathematical and not easy to present in abstract. It discusses Rankine's, B. F. Isherwood's, D. N. Clark's, C. E. Emery's and R. C. Carpenter's formulas for boiler efficiency, and concludes that none are an improvement on Rankine's, which is more simple and fits the experiments as well as any; with which we are bound to agree, in view of the data plotted, together with the curves representing the various formulas. These are as erratic as boiler data proverbially are, and the fit between the facts and the formulas is about as close as the traditional rat's tail in a quart cup. Seriously, we consider it absurd to build such a structure of mathematical work on such a set of erratic facts in the endeavor to discover a law, when the only thing we can say with confidence is, that if there be any law in the case at all, it is certainly not disclosed by the facts at hand.

The first speaker was Mr. Geo. I. Rockwood, who gave some interesting reasons for the wide use of economizers in England and their very limited use here. With the Lancashire boiler, so largely used in England, a square foot of boiler surface costs about three times as much as a square foot of economizer surface. Hence, in England it is a good rule to "buy as little boiler and as much economizer as possible." With American types of boiler, on the other hand, a square foot of boiler surface costs about one-half as much as a square foot of economizer. Hence, here the rule becomes "buy as much boiler and as little economizer as possible."

Mr. Wm. Kent referred to the Centennial tests as being the most complete on record, and stated that the best that could be said to-day was that the known data are erratic, and no line can be drawn with present knowledge to represent the law of efficiency as related to the evaporation per square foot of heating surface. "What we don't know about boilers would fill a big book."

Following this, quite a tilt occurred between Mr. W. Barnet Le Van and Mr. Kent, in which the former assailed the Centennial tests as unworthy of confidence, and the latter defended them.

Paper Friction Wheels.

BY W. F. M. GOSS, LAFAYETTE, IND.

This paper is one of the kind of which we should have more from the laboratories of our engineering schools. Paper friction wheels are extensively used in certain sections, and with very satisfactory results; but, nevertheless, there is little or no information in print by which one who has no immediate experience in their use can proportion them for a given duty. Professor Goss has made extended experiments on these wheels, and puts the results before us in such shape as to fill this gap. The conclusions arrived at in the paper are that a pressure of 150 pounds per inch width of pulley may be safely used, and that with this pressure the horse-power carried may be expressed by the following formula:

$$H.\ P. = .000238\ d\ w\ n;$$

in which

d = diameter of friction wheel in inches,
w = width of friction wheel in inches,
n = revolutions per minute.

This formula is recommended for wheels of 8 or more inches diameter. For smaller wheels the experiments are less complete; but the indications are that for 6-inch wheels the driving power is less by about 10 per cent., and for still smaller wheels this difference may increase.

Stated in another way, for easy comparison with belt rules, the formula says that a pulley 1 inch wide, traveling at a peripheral speed of 1,100 feet per minute, will carry 1 horse-power. A rule in this form which is much used for belting is that a 1-inch single thickness belt, traveling 600 feet per minute, will transmit 1 horse-power, from which we see that these paper wheels may be expected to carry about one-half the power of a single belt of the same width and moving at the same speed.

Steam Engine Governors.

BY FRANK H. BALL, PLAINFIELD, N. J.

This paper is a very clear description of the principles that lie at the base of the operation of inertia governors. It contains no mathematics, and does not attempt to make any calculations regarding the forces at work in a governor, but analyzes the action of the various forces by the aid of diagrams and simple language. It will no doubt help to clear up a lot of fog with which the conception of these newly applied forces is enveloped in many minds.

A portion of the paper is historical, and Mr. F. A. Halsey showed by blackboard sketch the Shive governor, which is still in use in the vicinity of Philadelphia. This governor appeared in the early 70's, and was an unmistakable inertia governor, and preceded any governor mentioned by Mr. Ball. He also thought that insufficient credit had been given to Professor Sweet in connection with the beginning of really refined regulation.

The Metric vs. the Duodecimal System.

BY GEO. W. COLLES, BOSTON, MASS.

This is an extensive and exhaustive paper, occupying 98 pages. It examines the metric system from all standpoints historically, both as to its origin and its adoption by different countries, and especially discriminates between its formal adoption by government action and its actual adoption by the people, between which, according to the author, there is a great gulf fixed. The paper also examines the system critically as to its merits, and on this point the author aggressively opposes it. The paper is the first formal and critical piece of opposition to the system that has appeared in some years, and is, so far as we know, the most complete examination of the subject from the side of the opposition that has ever been presented. We predict that it will become the storm center of the contest.

The paper was discussed from both sides, the sympathy of the meeting being obviously with the author. Mr. R. N. Fairbanks controverted some of the author's statements of facts, and Mr. A. L. Rohrer contended, from the experience of both engineers and workmen whom his company (the General Electric Company) had sent to France, that the adoption of the system was not nearly so formidable a matter as is generally believed.

Aluminum Bronze Seamless Tubing.

BY LEONARD WALDO, BRIDGEPORT, CONN.

The author presented photographs and samples of this material, which possesses

(Continued on page 35.)

American Machinist.

Published every Thursday
by the

American Machinist Publishing Co.,
256 Broadway, New York.

Angus Sinclair, Pres't. John A. Hill, Treas.
C. A. Hansmann, Sec'y.

C. P. Day, Manager Adv. Dept.

Fred J. Miller, Editor.

Frank Richards,
F. A. Halsey,
Edward P. Buffet, } Associate Editors.

A. L. Donnell, Dept. of Illustration.

▲ ▲ ▲

Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

▲ ▲ ▲

SUBSCRIPTION PRICE:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers. Everywhere.

▲ ▲ ▲

The Mechanical Engineers.

Another most successful meeting of the American Society of Mechanical Engineers now goes on record. The story of what was said and done is told elsewhere in this issue as fully as our space will permit. It may be safely said that all who attended the meeting received both pleasure and profit therefrom, and that the meetings are appreciated is sufficiently attested by the constantly increasing attendance, the number registered at the meeting being more than last year. The increased attendance this year made very evident the fact that the day is not far distant when larger rooms must be provided for the meetings. The house of the society, while excellently adapted to its uses all the rest of the year, is entirely inadequate for its annual meetings, and this remark applies not merely to the meeting room, but to the space available for social intercourse, and to the accommodations for the personal comfort and convenience of members and visitors. It is certainly in order for all interested to be looking a little into the possibilities of the future. While the honored co-workers of the Mechanical Engineers are building for themselves a permanent home, it is not too much to hope that the Civil Engineers are setting an example and giving a lesson that may be improved upon a little later.

When we come to look at the actual purposes proposed to be accomplished by the meetings of the society, and at the measure of success with which those purposes are accomplished, there is one remark that it seems to be increasingly necessary to make. It is much to be regretted that the papers to be presented at the meetings of the society cannot be in the hands of the members at an earlier day, to give an opportunity for the preparation of proper discussion. This evil was more pronounced at the recent meeting than ever before. The papers sent out were received only a week or so before the meeting by the members who asked for them, and four of the most important of the papers on the list were not seen by the members before the meeting. It has often happened at meetings of the society that the discussion of papers presented has brought out matter more interesting and valuable than that contained in the papers themselves, so that what will promote profitable discussion is of the greatest importance. Mechanical engineers, as a class, are not professional talkers, and to some of the best and most original and independent thinkers among them extemporaneous speech is almost an impossibility. It might not be so much the quantity as the quality of the discussions which would be promoted by allowing more time for preparation, as all the allowable time is fully occupied at every meeting; but it is quality which counts for the honor of the society and for the profit of its members. With more deliberate preparation there would also be less likelihood of straying off upon irrelevant and less profitable topics. The remedy for the growing evil here alluded to must be with the individual members rather than with the officers, whose duties and labors we know to be already greatly more tedious, on account of the dilatory actions of some otherwise valued and respected contributors. While the complete report of the proceedings of the meeting just closed will probably fill more pages than that of the last annual meeting, and while it will be of perhaps the average interest, and in parts unusually interesting, we are still warranted in saying that it would have been more valuable if more time for deliberate previous thought had been possible.

It is scarcely within our province to speak here in detail of the papers presented at the meeting. They were all upon topics of interest to the mechanical profession, but few striking novelties or even pronouncedly up-to-date matters appeared. We had nothing about electricity, compressed air, oil or gas motors, or the other most prominent mechanical interests of the day. The excellent address of President John Fritz and the opening paper by Sir Henry Bessemer were essentially reminiscent and historical, telling entirely of what has been done rather than of what is being done, or looking out to see what may or will be done and how it may be done in the future. In the discussion of Sir Henry Bessemer's paper there was plain talk, but the evident intention was to do justice and to see that the honors of achievement should rest where they belong.

▲ ▲ ▲

The Enforcement of Physical Laws.

What is spoken of in the daily papers as a "singular" accident, attended with a fatal result, is only a repetition of the now too familiar one where a man heats a hollow piston and it explodes and kills him. The last case heard from was in New Orleans, November 27th. Edward Schwind, presumably a partner of the firm of Boland & Schwind, put the hollow piston in the fire so as to get it off the rod easily. In a short time a violent explosion occurred; a piece of the casting struck Schwind in the stomach and he died in a few minutes.

It would seem brutal for any one to say that the result "served him right," and yet why should it be so? You may throw yourself upon the track of the Manhattan Elevated Railroad, in front of one of their locomotives, which never have a fender, and when you are killed the "served him right" is so obvious that no one thinks it worth while to say it. Wherein is the difference? Fire will burn, the wheels of heavy vehicles will crush, and the heating of water in a closed vessel will cause an explosion. The consequences follow the conditions with impartial justice in either case.

Civil laws have their penalties which may sometimes be successfully evaded, but with physical laws the effects follow the cause and are commensurate with it inevitably. The punishment fits the crime and follows the crime; is, indeed, an inseparable part of the transaction.

In civil law it is an established maxim that ignorance of the law shall excuse no one, and yet in practice it is often considered a mitigating circumstance and helps to avert the penalty. In physical laws the same maxim applies in its fullness; ignorance of the law has not the slightest influence in modifying the consequences of the transgression. Whether the man heating the piston knew the danger or not did not in the least affect the force of the explosion or change the direction of any flying fragment.

The burnt child dreads the fire, and the pain or punishment teaches him to avoid it. The death penalty, which Nature never hesitates to inflict, can scarcely be considered to be very instructive to the individual victim; but the knowledge of it enforces the lesson to others, and the catastrophe also, to some extent, promotes the "survival of the fittest."

Still, it is deplorable that men who have every means of knowing better, and every incentive to know better, will continue to do these things. There seems to be no way to prevent them, and all we can do is to keep on telling of the casualties as

they occur, although more cheerful matter, and also more profitable, would be preferable. We must continue to pay our tribute to ignorance, folly and recklessness by telling how not to do things, as well as how to do them, and by rehearsing the consequences of the wrong-doing.

▲ ▲ ▲

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(205) E. E J., Chicago, Ill., writes: Richards' "Compressed Air" gives the power cost of compressed air, but shows no way of getting at the actual coal consumption in steam-actuated compressors. I have a case where it is very desirable to know this; can you help me? A.—To the theoretical power cost of adiabatically compressing the air, as given on page 92, add, say, 20 per cent. to cover the friction and other losses of the compressor. This should give the power required to compress the given volume of air, and the coal consumption of the steam cylinder may then be ascertained the same as with any stationary engine, varying with the type of engine employed. For with a plain slide valve, the coal consumption would not be less than six pounds per horse-power hour, and would be likely to run considerably above that. Say that with a steam-actuated compressor of the familiar slide-valve pattern we wish to compress 500 cubic feet of free air per minute, delivering it at a gage pressure of 75 pounds, what would be the coal consumption? Proceeding as above, we find from the table that to compress 1 cubic foot per minute requires 0.15373 H. P. Then $.15373 \times 500 = 76.865$, and $76.865 + 20$ per cent. $= 92.238$ H. P. The coal consumption will then be $92.238 \times 6 = 554$ pounds per hour. There are so many conditions affecting this result that it is not worth while to go into the question more minutely unless these conditions can be known. There is a compressed-air plant not a thousand miles from where we write, comprising a large Corliss compound-condensing compressor, and another a single-cylinder non-condensing slide-valve compressor, the latter compressing about one-third as much air as the former. At times these compressors are run separately, and the engineers assert that one consumes as much steam (and coal) as the other.

▲ ▲ ▲

Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 14.
For brass work, try H. D. Phelps, Ansonia, Ct.
Small brass work. H. D. Phelps, Ansonia, Ct.
Brass pattern work. H. D. Phelps, Ansonia, Ct.
Machinery castings. H. D. Phelps, Ansonia, Ct.
Pat'n cast'gs a spec'lty. H. D. Phelps, Ansonia, Ct.
Fine cast'gs at fair prices. H. D. Phelps, Ansonia, Ct.
Brass turning done by H. D. Phelps, Ansonia, Ct.
Bronze pattern cast'gs. H. D. Phelps, Ansonia, Ct.
Good brass castings. H. D. Phelps, Ansonia, Ct.
Fine pattern castings. H. D. Phelps, Ansonia, Ct.
Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.
Milling Machs. Kempsmith Co., Milwaukee, Wis.
Ideal Twist Drill Grinder. T. Hall, 853 B'way, N.Y.
Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.
Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.
Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

▲ ▲ ▲

N. Y. Meeting of A. S. of M. E.

(*Continued from page 33.*)

remarkable properties for a bronze, especially that of retaining its ductility when hot. It is expected to find large use for boiler tubes. The author claims that the evidence favors the assumption that the bronze is a true chemical combination, instead of being a mere alloy or mixture.

The discussion consisted of some questions and replies.

This paper concluded the regular program, when Professor Hutton arose and announced the presentation to the society, by Mr. F. H. Stillman, of the first hydraulic jack ever made—the invention of Mr. Richard Dudgeon. The interesting relic, which is in an excellent state of preservation, was shown and will make a notable addition to the society's growing collection of such things.

With an expression of thanks from retiring President Fritz, the meeting closed, which, in point of numbers in attendance, far surpasses all previous records—that number being 556, whereas the highest previous record is 426. In other respects, too, the meeting was fully up to the standard. The interest in the papers and the warmth of the discussions were all that could be desired, while the growth of the sociable feeling was a matter of common comment.

▲ ▲ ▲

A Home-Building Enterprise.

A movement of very considerable importance has been initiated in New York by what is called the "City and Suburban Homes Company." The management of the company is in the hands of very well-known and highly reputable citizens, whose object is to do away with the frightful evils of the tenement house system, by building within the city and in suburban localities dwelling houses and tenement houses of approved design, and so conducting affairs that these houses can be rented or sold to those who dwell in them, upon much more favorable terms than are usually obtainable. It is expected that 6 per cent. will be realized upon the money invested, and it is not designed to make more than this; and as the movement is founded partially upon public spirit and a desire to improve the condition of city life for those whose incomes are limited, the company will avoid many of the items of expense that would attend an ordinary commercial enterprise which should attempt to do the same work.

We have seen plans of the improved tenements which it is proposed to erect in this city, and from them it is evident, that by using a larger plot of ground than is ordinarily used for the purpose, or, in other words, using several city lots as one, larger tenement buildings than the present ones can be erected which shall be much better from a sanitary and from every other point of view

It is announced that the president, Dr. E. R. L. Gould, 281 Fourth avenue, New York, will be glad to give full information regarding the matter, and our investigation of it convinces us that this enterprise is likely to be a move in the right direction. It is, in fact, an attempt to help wage-earners who live in the city to avoid some of the increased expense attending city life which results from speculation in real estate, and to do away with some of the overcrowding which is an attendant feature.

▲ ▲ ▲

Secretary Lamont has awarded to the Bethlehem Steel Company the contract for supplying ten sets of 5-inch siege gun forgings at 27½ cents per pound, and ten sets of 7-inch howitzer forgings at the same figure. The Midvale Steel Company secures the contract for supplying twenty sets of forgings for 7-inch mortars at 31 cents per pound, and thirty sets of forgings for 3.2-inch field guns at 32 cents per pound. There was no award made for forgings for 3.2-inch field mortars, the lowest bid being 60 cents per pound. Bids for the above forgings were invited about three months ago, but the Secretary was not satisfied with the figures submitted and issued a new advertisement. The figures submitted by the two companies were a duplication of those submitted under the first advertisement, and thereupon Secretary Lamont awarded the contracts as above.

▲ ▲ ▲

At the works of Les Chemins de Fer de l'Est, at Epernay, France, a locomotive was recently erected in 107 hours. It is not claimed that this breaks the record, either for Great Britain or the United States, but the French locomotives are of more complicated design. The different groups of men employed on the job are divided as follows: Erectors, 158 hours; erectors' apprentices, 305 hours; machinists, 220; machinists' apprentices, 224; riveters, 174; riveters' apprentices or holders-up, 58; tube hands, 221; boys, 93. This makes an average of 13.5 employed for the whole time. The proportion of apprentices or boys employed seems to be much larger than would ever occur with us.

▲ ▲ ▲

Recently in a town in France a tubular boiler 15 feet high was being drawn by sixteen horses, two men on the car keeping the overhead electric wires clear of the top. The men accidentally let the wires touch the boiler, and a terrible scene ensued. All the horses were struck down, and several were killed and severely burned. Some of the men were not expected to recover.

Some wise and honored men sometimes do not know what they are talking about, and they talk just as well. Mr. Gladstone has said somewhere that to perfect the locomotive has not required the expenditure of more mental strength and application than to perfect the violin. Still there is hope for the locomotive. It is not yet perfect and is still improving, while the violin has not been improved in a century. More men are to-day tinkering at the locomotive than ever worked at once on the violin.

▲ ▲ ▲

Commercial Review.

NEW YORK, SATURDAY EVENING, Dec. 5.

MILL AND MACHINISTS' SUPPLIES.

It is not at all satisfactory, instead of recording an improvement in trade, to have to try to assign a reason for there not being any to speak of. But perhaps this is putting the matter too strongly; for in common with other branches of the market, supplies show a betterment in tone as compared with the conditions prevailing before election. Though not in all, nor perhaps in most cases are the sales reported materially greater than formerly, an improved inquiry is conceded by many sellers, and the prospects for business early in the coming year are dwelt upon with some apparent confidence.

December is considered a dull month for the machinists' supply trade. About the first of January occurs the principal stock-taking epoch of the year, and as that time approaches, buyers are less and less inclined to make investments. This is such a well-recognized phenomenon of trade that one can hardly be surprised to notice its appearance in spite of the election. So sellers are looking forward to January or February to see the boom that should have come after the election, but did not do so. It is pretty well settled that there is to be no boom at all; but there seems to be no reason why, when the time is ripe, there may not be a gradual and healthy revival of business. Only, as is cynically remarked, when people have waited till after stock-taking time, they will wait till after the 4th of March.

Four weeks ago, when the election had been passed by but a few days, we made inquiries of a few sellers as to the then condition of the market, and an absence of feature was reported with practical unanimity. The present retrospect of some houses is a slight flurry of trade following the election and lasting but a week or two, dying, perhaps, a natural death and kept moribund by the approach of stock-taking time. The cold weather of the past week has been by nature conducive to an increase of business, but in only one or two instances has such been reported to us.

THE FILE TRADE.

Here are the opinions of two prominent authorities as to this branch of the machinists' supply market. Mr. Foot, of Kearney & Foot, says:

"Our business has undergone no especial change since the election. December is the dullest month of the year with the file trade. After the end or the middle of January we expect to see an increase. We have noticed that industrial lines of business usually follow the stock market in an upward movement by about three months. Wall street advanced after the election, and we believe that after the first of the year there will be comparatively a boom in the file trade. Our factory is running upon the same terms of work as previous to the election. What has been said of files substantially applies to twist drills also. We have made no change in the prices of our files."

One of the factories, the news of whose starting into renewed activity went the rounds of the daily press the week of the election, was the Arcade File Works. Mr. Clarke, of Allerton, Clarke & Co., general agents for the same, says: Business has improved and we look for still more improvement. Our factory was running three days a week before the election and increased its operations afterward. At present some stock is being accumulated, though not a great deal. As it draws toward the end of the year, jobbers are disinclined to buy very much, although we have received some large orders. After the early part of January we think jobbers will buy more freely."

IN RE WOOD PULLEYS.

Wood pulleys now form a subject of some interest as well as complication. Litigation has been going on for seven years as to whether the Dodge Manufacturing Company shall have, to the exclusion of other makers, the use of the system of securing the pulleys on the shaft by compression. A recent decision in the United States Circuit Court at Columbus, O., has so strengthened the position of the Dodge Company that they have felt able to revise their discount list so as to advance the prices about 10 per cent. Some of the other makers are disposed to stand their ground and are guaranteeing protection to middlemen. What form the entire question will assume in the future, is hard to tell. On the one hand, it is stated that the last judicial decision is without appeal, and on the other it is claimed that it does not apply to the general Dodge interests.

THE TREND OF PRICES.

As a general thing, the prices of machinists' supplies have not yet been advanced. It is remarked that after the opening of the year and extended business, more or less increases will probably be made, but we shall wait until conditions are sufficiently improved to warrant such changes before expecting very confidently to see them. A certain emery wheel company, indeed, is at present disinclined to make contracts upon the present basis for a year ahead, believing that an advance will be justified in the meantime. As not altogether foreign to the subject of machinists' supplies, it may be mentioned that an increase of price has been made in the wrought-iron pipe market; also that cut and wire nails and wood screws have been marked down. The price of nails, which went up like a rocket, has come down like a stick with the demise of the Nail Pool, whose obsequies were celebrated this week.

NOTES ON EXPORTS.

A certain emery wheel company report that their export trade has been good during November.

Patterson, Gottfried & Hunter find that European trade is relatively flourishing, especially in the way of fine tools.

A general supply house who do considerable business with Spanish-American countries report that in spite of the Cuban war the demand from there for machinery, etc., seems to be picking up. Mexican trade they notice to be dull, Central American about holding its own, while in Brazil they are finding a market for some marine engines and boilers. As to matters of detail like these, it is not to be expected that the experiences of different houses will be altogether uniform. In general, Cuban trade seems to be very poor, and Mexican, unless merely temporarily quiet, is good.

The Laguayra Electric Light & Power Company, of Venezuela (office, 88 Wall street, New York), intends to change the power of its plant from steam to hydraulic, and asks bids for electrical and mechanical appliances.

It is stated that the National Small Arms Factory at Herstal, near Liege, Belgium, founded in 1890 and equipped principally with American tools, thirty per cent. of which were furnished by Pratt & Whitney, has during the past year added $140,000 worth of the tools of the same firm and of Brown & Sharpe.

Here are some reports which are afloat as to export trade in engineering goods, with the Far East: An American Ball engine is, or soon will be, on its way to the Chinese Government's mint, for coining silver. The five commissioners of the Japanese Government who are in this country after information preliminary to the erection of a small steel rail plant in Japan, have been looking around in Pittsburg. They intend to purchase an 8-ton converter and modern machinery. The 15,000 tons of rails that the Carnegie Company contracted to furnish the Japanese Government were recently reported as being shipped. The Government of New South Wales desires

(Continued on page 37.)

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription list**, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Mechanical draftsman is open for engagement. Address Box 203, care AMERICAN MACHINIST.

Position wanted as f'rman or supt. by exp. mech.; held such positions before. Box 194, AM. MACH.

Foundry foreman open for position; A 1 references. Address Box 196, AMERICAN MACHINIST.

Wanted—Practical emery wheel maker to act as foreman; give age, experience and references. Box 202, AMERICAN MACHINIST.

Wanted—Pos. traveling; any line electric and hydraulic pr. transm'n machy.; exp. in mfr. and installation; write for details. Box 197, AM. MACH.

Wanted—Position by an expert pattern maker, competent to take charge; A 1 references as to character and ability. Box 198, AM. MACHINIST.

Tech. graduate with 4 yrs.' experience in locomotive works, 1 as asst. superintend't of stove works, desires position; references. Box 195, AM. MACH.

First-class mechanical draftsman desires position either as draftsman, estimating or superintending eng'r, or as a representative. Box 204, AM. MACH.

Wanted—Young man with good practical experience in England and United States wishes to represent an American manufacturer; can hustle. Box 201, AMERICAN MACHINIST.

A supt. of a concern employing 450 men is open for engagement; thoroughly familiar with shop and foundry practice; also estimating upon new work. Box 188, AMERICAN MACHINIST.

Wanted—Position in charge of machine room of bicycle works by reliable tool maker, aged 34; experienced with Cleveland and other automatic screw machines. Box 186, AMERICAN MACHINIST.

Gun and locksmith wanted in a Montana city; must be a first-class mechanic, thoroughly experienced and a man of deeds, not words; give experience, age, references and wages wanted. Address L. G., AMERICAN MACHINIST.

Assayer and Draftsman—Position open West for an energetic technical graduate, as assistant engineer to manager; great variety of work outside and in office; give references, age and experience. Address L. G., AMERICAN MACHINIST.

Competent parties, with some means, desire to correspond with owner of machine manufacturing plant or machine shop with a view to operating same, either by lease, percentage, rent or otherwise. Address Mechanical Engineer, AM. MACH.

Practical machinist and tool maker, with large experience in precise-working machinery as well as on general machy., desires position; has held foremanship for the last five years; best references as to ability and character. Box 199, AM. MACHINIST.

Do you wish to reduce expenses?—An energetic supt., 35, desires change; is thoroughly reliable and can come well recommended; machine tool shop pref'd; capable of taking entire charge of plant and is not afraid of overwork. Box 192, AMER. MACH.

Foreman boiler-maker wanted—First-class man who is familiar with marine and stationary boiler and iron ship work. Applicants will state age, experience, nationality, give names of previous employers, and must be well recommended. Address Waring & Dixey, 2033 American Tract Building, N. Y. City, N. Y.

Owing to a consolidation of business, a successful mechanical superintendent will be at liberty January 1st. Experienced in general shop and business management, costs, interchangeable work, tools, gauges, etc.; also general machinery and brass and iron work for steam, gas and water; strictly temperate and reliable; eight years in present position. Add. Box 168, AMER. MACHINIST.

A thorough machinist, age 36, who has been engaged in the machine and foundry business, desires to connect himself with some reliable firm where ability and push will count; well up in modern shop methods and management; can handle men, make drawings, solicit business, make contracts or handle correspondence; can give unqualified references as to character and ability. Box 179, AMERICAN MACHINIST.

Wanted—A thorough, practical mechanic as general foreman in high-speed engine works equipped with modern tools, employing about 100 men; must be familiar with machine work particularly and foundry and pattern work generally; should be skilled in modern methods of tool making and jig work and must be a good handler of men; an especially good man is desired; state salary wanted and give record of present and past work. Box 200, AM. MACHINIST.

▲ ▲ ▲

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

$5,000 buys one-third interest in a foundry and machine shop in the garden of Minnesota; well established business; excellent reasons for wanting a third partner. Box 193, AMERICAN MACHINIST.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st., N.Y.

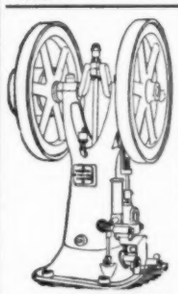
Wanted—An Idea. Who can think o some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Mr. Bookkeeper

do you know what the Comptometer is? It costs nothing to find out. It insures accuracy, is twice as rapid as the best accountant and relieves all nervous and mental strain. It would pay your firm to get one.

Write for Pamphlet,

FELT & TARRANT MFG. CO., Chicago.



This seats

Wind, Steam or Horse Power.

We offer the

WEBSTER 2 1-2 ACTUAL HORSEPOWER GAS ENGINE

For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.

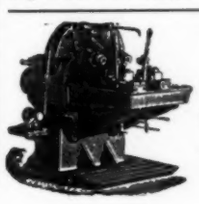
Write for Special Catalog

WEBSTER MFG. CO.
1079 W. 15th St., CHICAGO.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.



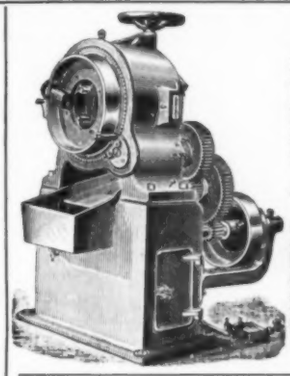
Automatic Solid Die Bolt.

THREADING MACHINES.

Two Styles. Four Sizes

Send for Catalogue "A."

WEBSTER & PERKS TOOL CO.
Cor. Spring and Monroe Sts.,
Springfield, Ohio.



CURTIS & CURTIS,
66 CARDEN ST., BRIDGEPORT, CONN.

Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

RADIAL DRILLS.

Wm. E. Gang & Co.

1105-1110 HARRISON AVE.,
CINCINNATI, OHIO, U. S. A.

(Continued from page 30)

bids for 150,000 tons of railroad material—steel rails, fish plates, spikes, etc.

It is worth noting, by the way, that a similar element of "paternalism" in national affairs is reflected in all these items, which is also true in connection with the locomotive plant which the Russian Government purchased in this country and which recently arrived at St. Petersburg.

A number of orders for pumping machinery for shipment to Mexico have recently been obtained by the Worthington Hydraulic Works.

The exports of all classes of manufactured goods from this country for October exceed those of any other month in the fiscal year beginning July 1st. They amounted to $23,479,279, against $18,778,817 in October, 1895, and $21,684,734 in September, 1896. Our summary of the items of miscellaneous machinery in manifests of cargoes outward bound from New York, reported by Custom House, during the week ending December 5th is $607,000.

THE IRON MARKET.

The volume of pig iron sold has been light, but this is what was expected, because it is settled that a halt has been called until after the first of the year.

Advices are to the effect that the downfall of the steel billet pool, which has already manifested weakness, has been rendered more certain by the withdrawal of one of its Ohio members.

Quotations.

NEW YORK, Monday, December 7th.

Iron—American pig, tidewater delivery:	
No. 1 foundry, Northern	$12 00 @ $13 00
No. 2 foundry, Northern	11 50 @ 12 00
No. 2 plain, Northern	11 25 @ 11 50
Gray Forge	11 00 @ 11 50
No. 1 foundry, Southern	11 75 @ 12 00
No. 2 foundry, Southern	11 25 @ 11 75
No. 3 foundry, Southern	11 00 @ 11 25
No. 1 soft, Southern	11 25 @ 11 50
No. 2 soft, Southern	11 00 @ 11 25
Foundry forge, or No. 4 Southern	10 75 @ 11 00

Bar Iron—Base—Mill price, in carloads, on dock; common, 1.15 @ 1.20c.; refined, 1.25 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward

Machinery Steel—Ordinary brands, from store, 1.70 @ 1.75c.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11¾ @ 11½; electrolytic, 11¼ @ 11⅜c.; casting copper, 11 @ 11¼c.

Pig Tin—For 5 and 10-ton lots, 13.00 @ 13.10c., f. o. b.

Pig Lead—In carload lots, 2.95 @ 3.02½c., f. o. b.

Spelter—In carload lots, New York delivery, 4.25c., f. o. b., for standard brands.

Antimony—Cookson's, 7¼ @ 7½c.; Hallett's, 6½ @ 6⅝c.; Japanese, 6¼ @ 6⅜c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 42 @ 44c.

▲ ▲ ▲

Manufactures.

George Mentyer is erecting a foundry at Harrisburg, Pa.

Meyer & Farrar, Carthage, N. Y., intend to erect a new factory.

McClave & Brooks will build a new foundry at Scranton, Pa.

A. E. Brown & Son of Easthampton, Mass., are building a new mill.

The Whitlock Coil Pipe Company, Elwood, Conn., are building a new shop.

Peace Dale Manufacturing Company, Narragansett, R. I., are erecting a new mill.

The Bridgeford Foundry Company, Louisville, Ky., intend to erect a new foundry plant.

It is expected that a new sugar factory will be erected in the near future at Ogden, Utah.

American Tin Plate Company, Elwood, Ind., will soon begin the erection of four more mills.

The University of Pennsylvania, Philadelphia, is having an addition made to its machine shop.

Efforts are being made to organize a stock company to build a new grist mill at Cicero, N. Y.

At Erie, Pa., an addition is being made to the Griswold plant on West Tenth street, that city.

Mr. Fred Manmann, 2119 East Tioga street, Philadelphia, Pa., intends to erect a new dyeing house.

The Stephenson Car Company of New York will soon remove its large car works to Elizabethport, N. J.

The Corrugated Iron Works, 514-518 Beach street, Philadelphia, Pa., intends to make additions to its plant.

The Franklin County Lumber Co. will erect a new planing and house furnishing mill at Greenfield, Mass.

W. D. Warren, of Rockport, and Mr. Martindale, of Indianapolis, will erect a flouring mill at Shirley, Ind.

The Metallic Roll factory, Indian Orchard, Springfield, Mass., intends to place new machinery in its plant.

At Birmingham, Ala., a new cotton mill of immense capacity is to be built by Mess. Trainer, of Chester, Pa.

J. D. Evans, Danvers Centre, Mass., intends to build an addition for the accommodation of an engine and boiler.

A new beet sugar factory is being erected at Santa Cruz, Cal., which will have a capacity of 3,000 tons daily.

The Renfrew Manufacturing Company, Adams, Mass., will erect a 100 x 100 feet one-story addition to its dye house.

Work is to be begun at once on a large addition to the plant of the Day-Ward Manufacturing Company, Warren, O.

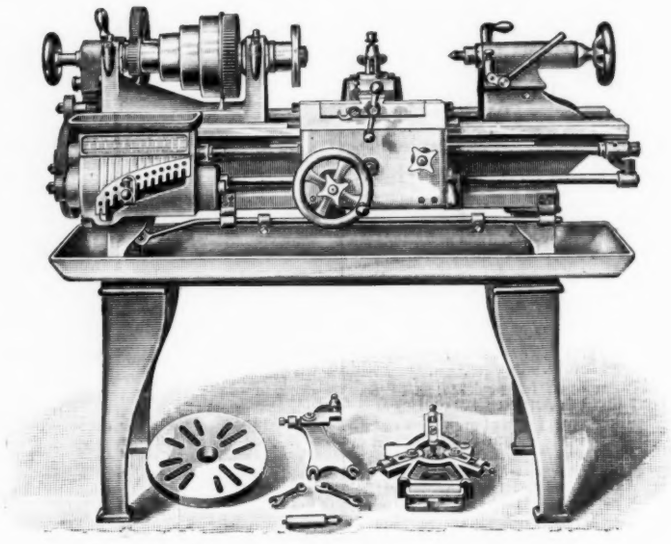
M. O'Rorke & Co., whose foundry is on Apple street, Peoria, Ill., intend to make extensive additions to their plant.

The Laidlaw-Dunn-Gordon Company of Tweedvale, Ohio, will erect a new foundry and pattern storage building.

The erection of a knitting mill at Columbia, S. C., is contemplated. Mr. W. B. Smith Whaley, Columbia, is interested.

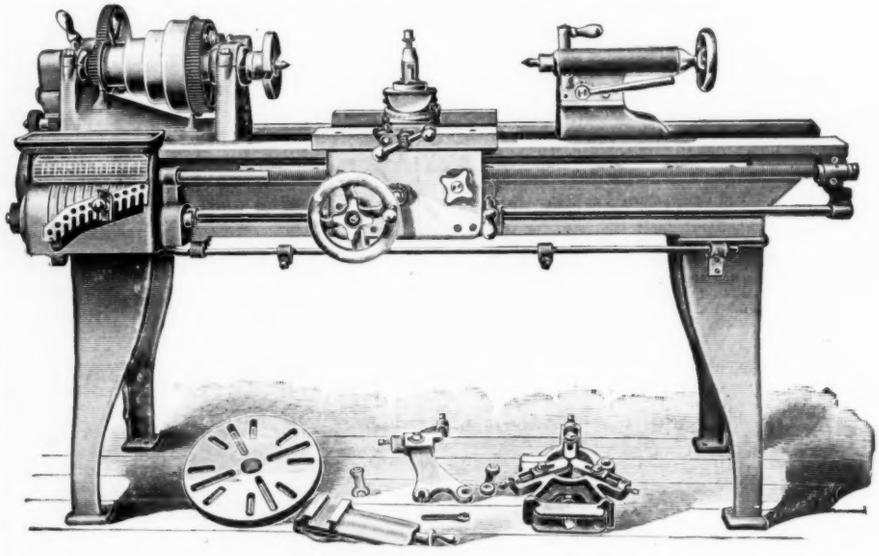
The Dunmore Electric Light, Heat & Power Com-

(Continued on page 39.



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co's standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterwards. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear-box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents: Chas. Churchill & Co., London and Birmingham, Eng.
Schuchardt & Schütte, Berlin and Vienna.
Eugen Soller, Basel, Switzerland.

The Pratt & Whitney Co. HARTFORD, CONN., U.S.A.

...MAKERS OF...

Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

England—Buck & Hickman, 280 Whitechapel rd., London, E.; Chas. Churchill & Co., Ltd., London and Birmingham. *France*—F. G. Kreutzberger; Fenwick Freres & Co., 21 Rue Martel, Paris.
Chicago—42 and 44 S. Clinton st. *Boston*—281 Franklin st. *New York*—123 Liberty st.

FINE SPIRAL FLUTED TAPER REAMERS.
Ground accurately to gauge.
SEND FOR CATALOGUE.
WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

Taper 1-2 inch to foot.

Taper 5-8 inch to foot.

SUITABLE FOR A CHRISTMAS PRESENT.

Kent's Mechanical Engineers' Pocket Book.
12MO, MOROCCO, $5.00.
JOHN WILEY & SONS, 53 East 10th Street, New York City.

9 to 15 in. Swing.
CATALOGUE FREE.

4 POINTS!!!! Design! Workmanship! Material! Finish!
All these are comprised in the make-up of our lathes and are the four necessary points in the construction of a good tool. Add to these a FIFTH and a very important one, the price, which we make very low to prompt cash buyers, and you have the story. Our Catalogue will tell you all about our Lathes, Planers, Shapers, etc.
SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U.S.A.

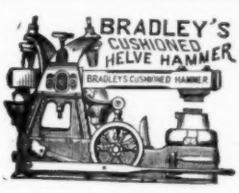
DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N.Y.
Have done all my patent soliciting work, both for this and foreign countries, continuously for the past fourteen years.
Thomas A. Edison

STAR LATHES
★★★
Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12" Swing.
Send for Catalog B.
Seneca Falls Mfg. Co.
687 Water St., Seneca Falls, N.Y.

WE CLAIM THE FOLLOWING MERITS FOR JENKINS BROS.' VALVES.
1. Manufacturered of the best Steam Metal.
2. No regrinding, therefore not constantly wearing out the Seat of the Valves.
3. Contain JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
5. Every Valve Tested before leaving the factory.
6. ALL GENUINE stamped with Trade Mark.
JENKINS BROTHERS, New York, Philadelphia, Chicago, Boston.

EMERY WHEELS
NORTON Emery Wheel Co.
Worcester, Mass.

NEW COMPLETE ILLUSTRATED CATALOGUE FREE.



BRADLEY HAMMERS
THE BEST POWER HAMMERS ON EARTH.
22 sizes in Helve, Upright and Strap Styles.
Send for Printed Matter.
The Bradley Company
Syracuse, N. Y.

(Continued from page 38.)

pany have selected a site at Scranton, Pa., on which to erect its plant.

J. Franklin Stuckert & Son intend to erect a new engine and boiler house on Fourth and Berks streets, Philadelphia, Pa.

H. C. Mellor's ten stamp mill at Quigleyville, Colo., was burned recently, and it is the intention of Mr. Mellor to build a larger one.

J. W. Place & Co., New York, are to erect a silk mill at Reading, Pa. It will be equipped with the most improved type of machinery.

The Wellsville, O., Plate and Sheet Iron Company is doubling the capacity of its plant. It is owned by W. D. Wood & Co., Pittsburg, Pa.

The Hall Safe Company has been organized at Cincinnati, and has leased a building in Cumminsville which will be equipped with machinery.

Arbuckle Bros., of Brooklyn, N. Y., have, it is said, given a contract for the erection of a new sugar refinery with a capacity of 2,000 barrels per day.

A new main foundry will be built as an addition to the Laidlaw-Dunn-Gordon shops at Tweedale, Hamilton, O. It will be 300 feet long and 113 feet wide.

The Phœnix Mill Company of Philadelphia has leased the Campbell Woolen Mill in Chester, Pa., and will install about $50,000 worth of new machinery.

The Thomas Clough mill at Chester, Pa., has been leased by a Brooklyn firm who will put in special machinery to manufacture patent railroad signal lanterns.

At St. Louis, Mo., an electric light plant is expected to be built by a company formed for the purpose. S. Rothgiesser & Bro., Chas. H. Thuner and Ben. Westhus are interested.

The Union Drawn Steel Company, Beaver Falls, Pa., is erecting a brick building, 70 x 40, on the lot north of and adjoining their office, fronting on Seventh avenue. The building will be one story high.

Pease Bros., Des Moines, Ia., will soon begin the erection of a large brick building in which to manufacture bail ties. The building will be located on the Rock Island tracks either at Eighth or Ninth streets.

Fibre Lumber Company, Sault Ste. Marie, Mich., are preparing to make extensive improvements to their plant this winter. A 50-horse power boiler and engine will be put in their mill, also other machinery.

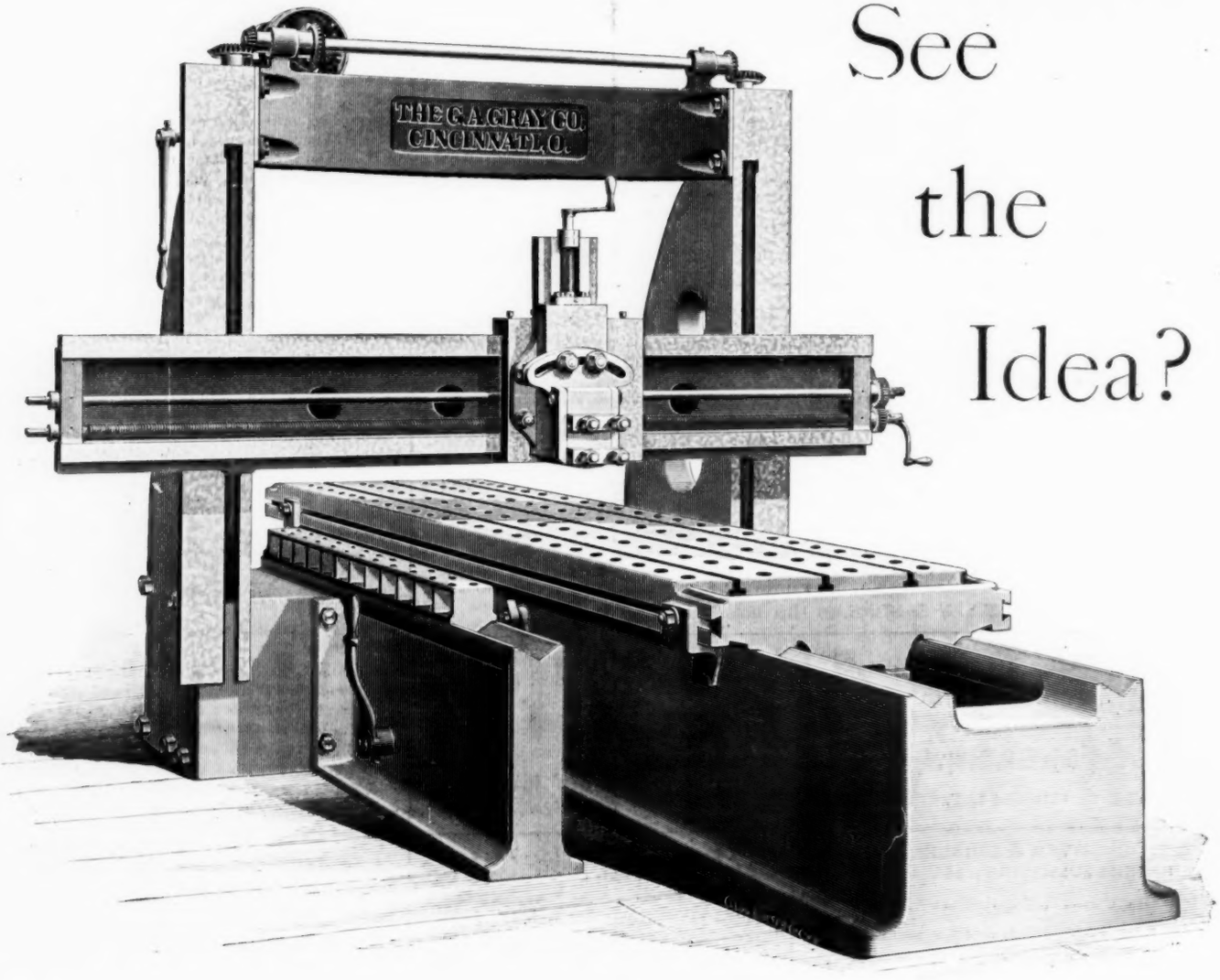
Peter McConackie & Co., Slatington, Pa., machinists, have purchased the site of the foundry and machine shop which was destroyed by fire several months ago, from Hon. D. D. Roper, and will erect a new shop thereon.

The Norristown Electric Light and Power Company, Norristown, Pa., has purchased of Dean & Mitchell, for $8,000, an acre of land along the Schuylkill, on which a modern power house, with improved machinery, will be erected.

The Union Loop Company will build a big power house at 280 Market street, Chicago, Ill., to furnish motive power to propel cars on its tracks. The building will be two stories and basement, of brick, 157 x 141 feet and will cost $250,000.

The new buildings of the Northwestern Lumber Company, Hogmain, Wash., will be completed about December 30th. The main building will be 52 x 300 feet, with an L 40 x 60, with a capacity of 1,000,000 feet. The main saw will be a double circular, and the mill will also have a 9-foot band saw, gang edger, gang trimmer and gang slasher.

It is understood that Wm. McVoy & Son, Minneapolis, Minn., have let the contract for the erection of a woodenware manufacturing plant complete, at Twenty-ninth avenue N.E. and Marshall street. Specifications for main building, 64 x 128, two story, frame, stone foundation; power house, 32 x 60, solid brick, iron roof, equipped with boilers, engine, pumps and other machinery; dry kiln, 32 x 96, frame, with modern equipments.



See the Idea?

MANY jobs require great width between housings, but not so much in height. If the work is not excessively heavy, a *widened* planer is all that is required, and the cost is much less than a regular machine of same width. Ordinarily, planers are widened by extending the housings equally on both sides; but on the type of planer herewith illustrated, the front side is left absolutely unchanged, and therefore the originally handy relation of parts there is not affected. We merely extend the left-side "cheek piece" as far as required and then permanently bolt the housing to it, same as on regular machine. The cross-rail is in each case designed to suit the increased span, and same being supported by rigid housings at both ends, insures as much stability as any regular planer.

In cases where the planer has been widened to its extreme width, and where the overhanging work is of such a character as to make an outside support desirable, we furnish a **Supplemental Guide and Slide** as shown on accompanying cut, which represents 38" x 38" planer widened to 60". The intention is to firmly block or wedge up the overhanging work on the supplemental slide and thus practically make a 3-track planer, on which work can be planed smooth, accurate and true, even at the extreme overhanging side. The shifter lever extended through the supplemental guide, affords every convenience for controlling the action of the machine from both sides.

We have patterns for the following sizes of these Widened Planers:

Planes in Width.		Planes in Height.								
40"	x	30"	Widened from	30" x 30"	pattern.	60"	x	48"	Widened from	48" x 48" pattern.
50"	x	30"	"	" 30" x 30"	"	72"	x	48"	"	" 48" x 48" "
48"	x	38"	"	" 38" x 38"	"	72"	x	60"	"	" 60" x 60" "
60"	x	38"	"	" 38" x 38"	"	84"	x	60"	"	" 60" x 60" "

These Planers are furnished with one or two heads on rail, and with Side-heads on either one or both housings.

MANUFACTURED BY

THE G. A. GRAY CO., CINCINNATI, OHIO.

See our "Steady Advertisement" on Page 16 for list of our regular Selling Agents, European and Domestic.

Milling Machines,

Eight Sizes, Weighing From 1000 to 4500 lbs.

DESIGNS UP-TO-DATE,
QUALITY THE BEST.

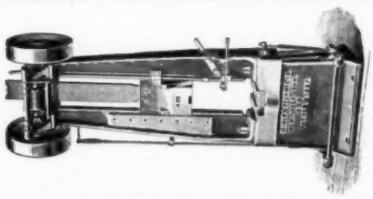
Send for information specially interesting to all Machinists and Bicycle Manufacturers.

KEMPSMITH MACHINE TOOL CO.
MILWAUKEE, WIS., U. S. A.

CUTTING OFF MACHINES, the Latest and Best.

HURLBUT ROGERS MACHINE CO.,
SO. SUDBURY, MASS.

German Agents: Schuchardt & Schutte, Berlin and Vienna.
English Agents: Chas. Churchill & Co., Ltd., London and Birmingham.

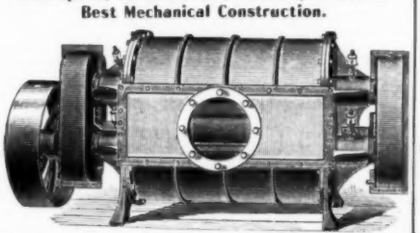


Miner & Peck Mfg. Co., New Haven, Conn

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO
WORCESTER, MASS.
Manufacturers of Set, Cap & Machine Screws, Studs, etc.

THE WATERBURY
FARREL FOUNDRY
AND MACHINE CO.
Waterbury, Conn., U. S. A.
BUILDERS OF MACHINERY FOR MAKING
STEEL GOODS
STEEL TUBE, BICYCLE PARTS, BRASS GOODS, SILVERWARE AND HARDWARE.

Roots' Force Blast Rotary Blower. For Foundries, Smith Shops, Pneumatic Tubes, Ventilation, Etc.
Slow Speed, Positive Blast, Perfectly Balanced. Best Mechanical Construction.



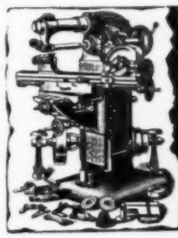
P. H. & F. M. ROOTS CO., Manufacturers,
CONNERSVILLE, IND.
NEW YORK OFFICE: 109 Liberty Street.
J. B. STEWART, Manager.
In writing please mention this paper.

Buffalo FAN SYSTEM OF HEATING & VENTILATING
BY A FORCED CIRCULATION OF WARM AIR.
ALL LARGE BUILDINGS.
CHICAGO OFFICE: 22 W. RANDOLPH ST.
NEW YORK OFFICE: 26 CORTLANDT ST.
BUFFALO FORGE CO
BUFFALO, N.Y.

FIRE FELT
FIRE-PROOF, REMOVABLE. ASBESTOS LIGHT, DURABLE.
SECTIONAL PIPE COVERINGS.
Sheet Fire Felt for boilers and superheated surfaces. Curved Sheet Lagging for boilers of locomotives
ASBESTOS CEMENT FELTING.
Asbestos Millboard, Steam Packings, Roofing, Liquid Paints, Fire-proof Paints, Cements, etc.
H. W. JOHNS MFC. CO., 87 Maiden Lane, New York.
CHICAGO. BOSTON. PHILADELPHIA.

CRANES, TROLLEYS, PORTABLE HOISTS; OVERHEAD TRACK.
SEND FOR CATALOGUE.

MARIS BROS.,
2343 & 2345 Callowhill St.,
PHILADELPHIA, PA.

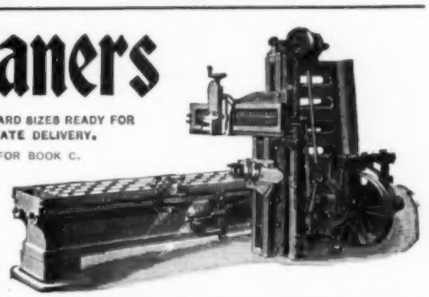


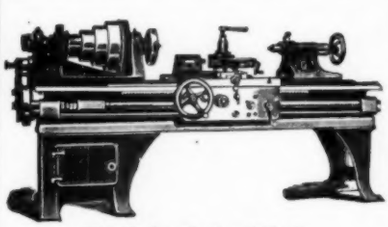
Incorporated 1871.
Brainard Milling Machine Co.
156 OLIVER ST. BOSTON, MASS. WORKS AT HYDE PARK, MASS. U.S.A.
UNIVERSAL PLAIN & SPECIAL MILLING MACHINES. ALSO CAM-CUTTING & MILL-GRINDING MACHINES.
MILLING & GEAR CUTTING MACHINES.
50 Different Sizes & Styles
Cuts & Prices on Application

THE Q AND C
GEN'L OFFICES CHICAGO ILL.
NEW YORK 100 B'WAY
BOSTON 70 KILBY

AUTOMATIC FEED SHOP SAWS NO. 2 & 4. CATALOGUE
LARGE POWER AND PORTABLE RAIL
SENT FREE.
OLD SAWS
CORRESPONDENCE SOLICITED.

Open Side Planers
STANDARD SIZES READY FOR IMMEDIATE DELIVERY.
SEND FOR BOOK C.
The Detrick & Harvey Machine Co.,
BALTIMORE, MD.





The Flather Lathe, 22 inch.

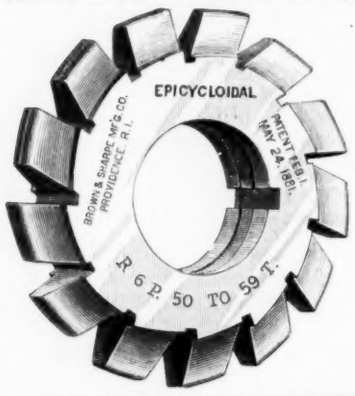
FLATHER & COMPANY,
NASHUA, N. H., U. S. A.
LATHES,
SCREW MACHINES,
PLANERS AND SHAPERS.

BROWN & SHARPE MFG. CO.

Machinery and Tools,

NEW YORK OFFICE, 136 Liberty Street, Room 507.
CHICAGO OFFICE AND STORE, 23 South Canal Street.

PROVIDENCE, R. I.



GEAR CUTTERS,

INVOLUTE AND EPICYCLOIDAL.

450 sizes regularly manufactured and usually carried in stock.

Sold by Hardware and Supply Dealers throughout the country.

Cutters of any size or form made to order.

Catalogue with price lists upon application.

BUCK & HICKMAN, 280 Whitechapel Road, London, E.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, England.
GUSTAV DIECHMANN & SOHN, Zimmerstrasse 87, Berlin, S. W. 12.
FENWICK FRERES & CO., Rue Martel, Paris.
SCHUCHARDT & SCHUTTE (Small Tools), 59 Spandau r-strasse, Berlin C., and VII. Bez Breitegasse 17, Vienna.

WARNER & SWASEY,

CLEVELAND, OHIO.

IRON & BRASS-WORKING MACHINE TOOLS

Monitor Lathes, Turret Engine Lathes, Screw Machines,
Forming Monitors, Boring Mills.

SEND FOR CATALOGUE AND PRICES.

THE CONSOLIDATED SAFETY VALVE CO.

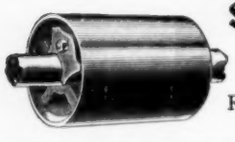
MANUFACTURERS OF

The Solid : : : : Nickel-Seated POP SAFETY VALVE.

The only Valve guaranteed not to corrode or stick. Made of the best materials, of perfect workmanship. They are absolutely reliable, durable, and never leak. Send for our book—"A PERFECT SAFETY VALVE." Sent free.

OFFICE & SALESROOM: 111 & 113 LIBERTY ST., NEW YORK.

424 TELEPHONE BUILDING, PITTSBURGH, PA. | 60 SOUTH CANAL STREET, CHICAGO, ILL.



Stuart's Patent Compression Wedge Coupling.

REQUIRING NO KEYS.

Have successfully stood the test for 9 years and are still being shipped *on trial, or money returned* if you want it. All sizes kept in stock.

R. J. STUART'S FOUNDRY AND MACHINE WORKS,
NEW HAMBURGH, N. Y.

Portable Key-Seater

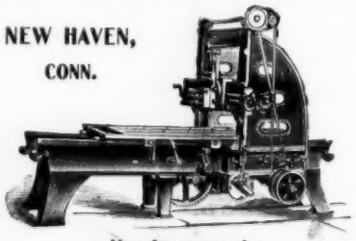
(PATENTED)

Cuts key-seats 12 inches long without re-setting, in middle or end of shaft, up to 5 inches diameter—Automatic feed—Quick return; depth gauge. Price, with full set of milling cutters, f. o. b. $40. Weighs 50 lbs. Larger machine for engine, ship-building and heavy mill work. Cuts up to 20-inch shaft.—3-inch keyways.

JOHN T. BURR & SON
South 6th St. and Kent Ave.,
BROOKLYN, N. Y.
Keyway Milling and Broaching Machinery.

NEW HAVEN MFG. CO.

NEW HAVEN, CONN.



Manufacturers of
IRON WORKING MACHINERY.
Catalogue AC.

Lathes.

BUILT BY

FIFIELD TOOL CO.

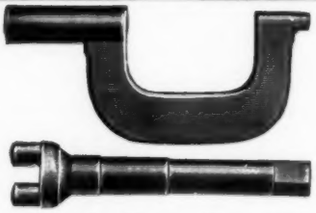
LOWELL, MASS.

PHOTOS, DESCRIPTION AND PRICE SENT ON APPLICATION.

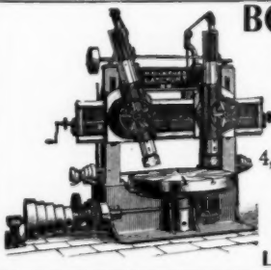
THE HARRINGTON & KING PERFORATING CO
PERFORATED METALS
OF EVERY DESCRIPTION FOR ALL PURPOSES
CHICAGO
227 N. UNION ST.
EASTERN OFFICE NO. 264 PEARL ST. NEW YORK

Wanted—An Idea

Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write JOHN WEDDERBURN & CO., Patent Attorneys, Washington, D. C., for their $1,800 prize offer and list of two hundred inventions wanted.



Fine Grade Drop Forgings.
WYMAN & GORDON,
WORCESTER, MASS.



BORING AND TURNING MILLS,

4, 5 & 6 ft. Swing

H. BICKFORD,
LAKEPORT, N. H.

JONES & LAMSON MACHINE COMPANY, SPRINGFIELD, VT.

SEE PAGE 14.

FLAT TURRET LATHE.